

970 1970

INTERNATIONAL PACIFIC SALMON  
FISHERIES COMMISSION

APPOINTED UNDER A CONVENTION  
BETWEEN CANADA AND THE UNITED STATES FOR THE  
PROTECTION, PRESERVATION AND EXTENSION OF  
THE SOCKEYE AND PINK SALMON FISHERIES IN  
THE FRASER RIVER SYSTEM

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SEP 3 1971

FISH & WILDLIFE SERVICE

# ANNUAL REPORT

## 1970

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### COMMISSIONERS

W. R. HOURSTON  
RICHARD NELSON  
RODERICK HAIG-BROWN

DeWITT GILBERT  
THOR C. TOLLEFSON  
CHARLES H. MEACHAM

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NEW WESTMINSTER

CANADA

1971

MEMBERS  
AND PERIOD OF SERVICE  
SINCE THE INCEPTION OF THE COMMISSION  
IN 1937

|                                  |                        |
|----------------------------------|------------------------|
| William A. Found . . . . .       | 1937-1939              |
| A. L. Hager . . . . .            | 1937-1948              |
| Senator Thomas Reid . . . . .    | 1937-1967              |
| A. J. Whitmore . . . . .         | 1939-1966<br>1968-1969 |
| Olof Hanson . . . . .            | 1948-1952              |
| H. R. MacMillan, C.B.E., D.Sc. . | 1952-1956              |
| F. D. Mathers . . . . .          | 1956-1960              |
| W. R. Hourston . . . . .         | 1960-                  |
| Richard Nelson . . . . .         | 1966-                  |
| Roderick Haig-Brown . . . . .    | 1970-                  |

|                                |                        |
|--------------------------------|------------------------|
| Edward W. Allen . . . . .      | 1937-1951<br>1957-1957 |
| B. M. Brennan . . . . .        | 1937-1942              |
| Charles E. Jackson . . . . .   | 1937-1946              |
| Fred J. Foster . . . . .       | 1943-1947              |
| Milo Moore . . . . .           | 1946-1949<br>1957-1961 |
| Albert M. Day . . . . .        | 1947-1954              |
| Alvin Anderson . . . . .       | 1949-1950              |
| Robert J. Schoettler . . . . . | 1951-1957              |
| Elton B. Jones . . . . .       | 1951-1957              |
| Arnie J. Suomela . . . . .     | 1954-1961              |
| George C. Starlund . . . . .   | 1961-1966              |
| Clarence F. Pautzke . . . . .  | 1961-1969              |
| DeWitt Gilbert . . . . .       | 1957-                  |
| Thor C. Tollefson . . . . .    | 1966-                  |
| Charles H. Meacham . . . . .   | 1969-1970              |



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CHARLES H. MEACHAM

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DIRECTOR OF INVESTIGATIONS

LOYD A. ROYAL

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NEW WESTMINSTER

CANADA

1971





DR. LOYD A. ROYAL

Director of Investigations of the International Pacific Salmon Fisheries Commission from 1950 until his retirement in February 1971. Dr. Royal joined the Commission 1949 as Chief Biologist and, following the death of Mr. B. M. Brennan, was appointed Director in 1950. His foresight and determination prepared a sound foundation for protection and management of the stocks of Fraser River sockeye and pink salmon.



# REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR THE YEAR 1970

With its responsibility to protect, preserve and extend the valuable sockeye and pink salmon fisheries of the Fraser River, this Commission must attempt to provide technical answers to ensure the fisheries do not suffer unnecessarily as the natural resources of the Fraser River Basin are developed. This responsibility is a monumental task. Even though the same problems have existed previously in other areas, and the Commission has had the benefit of data from those charged with similar responsibilities elsewhere, in many cases the problems have not yet been solved.

Each proposed project which may affect water within the Fraser River Basin and other parts of Convention waters is examined carefully, having in mind the previous experience of others. Where possible resource conflict is anticipated, the Commission attempts to find an answer or to provide the necessary scientific data to define the problem. The Commission then forwards its recommendations in respect to its terms of reference to either the Canadian or United States Government, whichever is most directly involved. The final decision rests with the people concerned and their government representatives. Obviously, the recommendations with their supporting data, like a presentation before a court of law, help determine the final decision. In many respects, it is this decision that directs the course of development and, fortunately, the maintenance of a desirable water ecology helps maintain a satisfying environment for the community.

In recent years, the Commission has been faced with a major pollution problem being created by rapid population growth and rapid expansion of a related industrial complex. For instance, five large pulp mills have either been built or are under construction in the Fraser River Basin. Since the discharge of domestic sewage in large streams has seldom, by itself, created a toxic or major stress factor on fish, this source of pollution has been considered to be more of a public health problem, up to the present time, than a threat to the fisheries. Because of this, the Commission has directed its research and recommendations primarily to the prevention of industrial pollution. A small staff of sanitary engineers and biologists was organized to conduct research and collect data for use by the Commission in meeting its responsibilities.

The past history of industrial pollution is quite clear. In earlier years, either the effluent was discharged without restraint, regardless of its toxic effects, or the waterways were considered a source for diluting the untreated effluent. Either practice frequently caused severe damage. Later attempts to set arbitrary water quality standards based on incomplete information caused confusion and frustration, not only to those responsible for preserving the fisheries and recreational resource, but also to industry as well.

Since these practices were unsatisfactory, the Commission adopted the principle that any effluent discharged in Convention waters should be nontoxic to sockeye and pink salmon before being discharged. The Canada Department of Fisheries

and Forestry has also adopted this same principle. New industry in the Fraser River Basin has been fairly reasonable in providing full treatment of industrial wastes, having in mind that any lesser pollution standard would end eventually in a chaotic situation, and without suitable environmental conditions, all efforts to improve the sockeye runs through increased fry production would be wasted.

The Commission, while empowered by the Sockeye Salmon Fisheries Convention to conduct fish cultural operations, recognized early in its existence that hatcheries left much to be desired as a means of increasing sockeye production. The great damage done to most of the upper river runs by the Hell's Gate obstruction had resulted in spawning escapements being well below the capacity of the spawning grounds, and the food supply of adjacent rearing lakes being greatly underutilized. In some streams, such as the Nadina River, the natural spawning areas were too limited in capacity to provide sufficient fry to utilize the available rearing capacity of the adjacent lake. In addition, logging and land clearing had caused localized deterioration of several smaller spawning streams.

Since the Commission was vitally interested in increasing fry production, the first investigations were directed towards isolating the reasons for hatchery fry being less viable and subject to a much higher mortality rate after release than that incurred by fry produced naturally. A conclusion was reached, after several years of investigation, that it was impossible to produce strong, healthy fry in the environment of even the most modern hatchery. Further investigations resulted in the development of artificial incubation and spawning channels as satisfactory methods for artificially increasing production of viable fry.

The success of the incubation and spawning channel in producing large increases in sockeye runs has been reported previously. In some instances the entire capital costs, plus interest, depreciation charges, and operating expenses, have been returned in one year of channel operation. However, the value of these projects depends on adjacent lakes which have sufficient rearing capacity to absorb the increased fry production. In certain large lakes in the Fraser Basin, the survival rate from fry to yearling smolts varies from 45 to 60 per cent under the natural lake conditions of predation and competition. It is the low operating expense of the channel, combined with the relatively high survival of fry to the smolt stage under natural conditions, which makes it possible for the channel to produce such a high dollar return. Since the sockeye is extremely sensitive to its reproductive environment, the success of the channel can only be assured at present where the original population is available and the water used has the same thermal environment as that utilized for natural reproduction.

Even though hatchery fry are weaker and smaller than those produced naturally or in artificial channels, modern pond rearing practices appear to compensate for these initial disadvantages for some species. Pond rearing of coho and chinook salmon as well as steelhead trout to migratory age has proven eminently successful in recent years. Declines in the relatively smaller runs of these species, caused mainly by adverse changes in the natural environment, have not only been halted by modern rearing operations but the same populations have been increased substantially.



Having in mind the possible future need for substituting both natural fry production and the required lake rearing area, the Commission for several years has conducted experiments in the pond rearing of sockeye at Cultus Lake. All of the knowledge accumulated in the design of successful rearing operations in the northwest United States has been gathered, and this information, combined with expert consultation, has guided the design of similar rearing operations utilizing Cultus Lake and other populations of Fraser River sockeye. Some of the difficulties encountered in rearing sockeye to the smolt or yearling stage have been eliminated. However, to date, all rearing experiments have proven unsuccessful apparently because of a greater sensitivity of this particular species to changes in its normal freshwater environment.

The foregoing illustrates in part the difficulties encountered in alleviating the adverse effects on Fraser River sockeye inherent in watershed development. Most, if not all, the potential problems created by industrial pollution can be avoided or solved with the cooperation of industry. Adverse environmental changes created by the removal of forest cover can be neutralized to some extent as far as sockeye and pink salmon are concerned by the use of artificial incubation and spawning channels.

In view of current interest in the hydroelectric potential of the Fraser River, the effects of such a development on the environment of the Fraser River and on the productivity of Fraser River sockeye and pink salmon becomes of paramount significance. Millions of dollars have been expended on studies of fish problems related to the construction of dams on the Columbia and Snake Rivers and to date no satisfactory solutions have been arrived at which would maintain salmonoid fishes in the Upper Columbia and Snake River Basins. Our studies show that the environmental changes which would result from the construction of a high dam or a series of smaller dams on the Fraser River below Prince George would be so massive in their effect on Fraser River sockeye that no artificial means are available to compensate for the destructive forces that would prevail.

The Commission considers it necessary under its terms of reference to report in detail to the proper government agencies on the unavoidable and disastrous effects the construction of a single high dam or a series of lower dams would have on the valuable Fraser River sockeye runs and ultimately on the economy of the fishing industry.

## COMMISSION MEETINGS

The International Pacific Salmon Fisheries Commission held nineteen formal meetings during 1970 with the approved minutes of these meetings being submitted to the Governments of Canada and the United States.

The first meeting of the year was held on February 2 and 3 with Mr. W. R. Hourston serving as Chairman and Mr. DeWitt Gilbert as Vice-Chairman and Secretary. The Commission accepted the resignation of Mr. P. Jenewein who had

been an Advisory Committee member representing Canadian gill net fishermen since 1948. On February 3 the Commission met with its Advisory Committee composed of the following members:

| <i>United States</i>                  | <i>Canada</i>                                             |
|---------------------------------------|-----------------------------------------------------------|
| N. Mladinich<br>Purse Seine Fishermen | F. Bublé<br>Purse Seine Fishermen                         |
| R. Christenson<br>Gill Net Fishermen  | E. Arkko (temporary representative)<br>Gill Net Fishermen |
| J. Plancich<br>Salmon Processors      | K. F. Fraser<br>Salmon Processors                         |
| J. Brown<br>Reef Net Fishermen        | M. Guns<br>Troll Fishermen                                |
| C. Mechals<br>Troll Fishermen         | H. Stavenes<br>Purse Seine Crew Members                   |
|                                       | R. Wright<br>Sport Fishermen                              |

The tentative recommendations for regulatory control of the 1970 sockeye salmon fishery in Convention waters, as submitted to the Advisory Committee by the Commission on December 16, 1969, were reviewed and certain revisions made on the basis of representations of the Committee.

On March 13, 1970 the Commission met in executive session to discuss administrative problems affecting the operation of the Commission. Mr. Roderick Haig-Brown was introduced as the new Canadian Commissioner replacing Mr. A. J. Whitmore who retired in 1969. The Commission recommended that the two separate regulations prohibiting net fishing for sockeye and pink salmon on the high seas portion of Convention waters, previously adopted in 1957, be replaced by a single regulation incorporating both species. Following approval by the two governments, the regulations were published May 28, 1970.

The third meeting of the year was held on May 27, 28 and 29. The Commissioners inspected Commission facilities at the Upper Pitt River Field Station, Weaver Creek spawning channel and the Sweltzer Creek Field Station, and visited the site of the proposed Chilliwack River pink salmon channel. Staff reports were given on the following subjects: 1. Experimentation with a new drug to prevent prespawning mortality of sockeye salmon, 2. Status of waste treatment systems being used in existing pulp mills, 3. Effect of decaying bark on sockeye eggs and fry, 4. Tests conducted in a stamina tunnel to assess the performance of sockeye smolts of various races, and 5. Results in long-term bioassays to determine the sublethal effects of copper on pink salmon eggs and alevins. In view of the recent success of artificial spawning channels the Commission approved an expanded construction program for increasing the sockeye and pink salmon runs, and in accordance with this policy, the Commission unanimously accepted the proposed budget for 1971-1972 which included an item of \$400,000 for channel construction.



On June 29, a special meeting was held with representatives of the United States Department of Interior to discuss a brief submitted by the Makah Indian Tribe of Neah Bay, Washington. As a result of this meeting, the Commission recommended the United States Convention waters lying westerly of Angeles Point be opened on July 12 and be subject to the same fishing periods as prescribed for United States Convention waters lying easterly of Angeles Point.

Twelve formal meetings and several telephone conferences were required between July 21 and October 6 to achieve, by adjustment of fishing regulations, the desired escapement and equitable division of the allowable catch of Fraser River sockeye salmon and also deal with other subjects involving Commission operations. One of the referenced meetings, held on July 31, included members of the Advisory Committee. At this meeting regulatory problems related to the Chilko and Stellako sockeye runs were discussed. Mr. Frank Nishii was officially appointed as the Canadian gill net representative. The Commission also announced a four-year term for all newly appointed Advisory Committee members with reappointment subject to review by the Commission.

The seventeenth meeting of the year was held on October 17 with the Honourable Jack Davis, Minister of Fisheries and Forestry of Canada, Ambassador Donald L. McKernan, Assistant to the United States Secretary of State for Fisheries and Wildlife, and the Advisory Committee in attendance. The Commission discussed the renewed interest in the proposed Moran Dam on the Fraser River and requested that the 1958 report on potential fisheries losses and problems associated with the dam be updated and submitted to the two governments. The Commission also discussed the possible future use of thermal power plants and recommended a report be prepared in conjunction with the Canada Department of Fisheries and Forestry on potential locations for thermal plants which would avoid serious conflict with fisheries resources. Additional subjects discussed included: 1. A review of the 1970 sockeye run size and regulatory problems, 2. Status of construction of the Nadina River spawning channel, currently delayed due to problems in obtaining adequate funds from the United States Government, 3. Potential increase in sockeye production from several underutilized northern lakes through the use of artificial channels, and 4. Channel improvements at the Adams River. The Chairman announced the Commission's Director, Mr. Loyd A. Royal, had requested retirement effective March 1, 1971. An inspection was made of the Adams River spawning grounds and the channel changes made to increase fry production.

On November 30 the Commission held its eighteenth formal meeting of the year. Mr. Gilbert advised the Commission of the resignation of Mr. Charles Meacham as a United States Commissioner. The Commission discussed the difficult regulatory problems facing the Commission for the 1971 fishing season in view of the small predicted pink salmon run and the relatively large subdominant Adams River sockeye run which possibly would be migrating at the same time.

The nineteenth and final meeting of the year was held on December 17 and 18, with the first day devoted to general business and a special meeting with the Advisory Committee to consider the serious problem facing the Commission in

the management of the 1971 sockeye and pink salmon runs. The characteristics of the 1970 fishing season, the related escapements and spawning environment, and a summary of the possible factors influencing the size of the 1971 Fraser River sockeye and pink runs in Convention waters were discussed at the open meeting on December 18, attended by approximately 600 representatives of the fishing industry and other interested groups. Reports were also presented on the following topics: 1. Methods of attaining the full potential sockeye production in northern lakes, 2. Methods of channel management and operation, 3. Results of experimental treatment with the drug P7138 to prevent sockeye prespawning mortality, and 4. Comparison of pulp waste treatment methods in the Fraser system and elsewhere. Tentative proposals for regulating the 1971 fishery were released subject to further consideration by members of the industry and their representatives on the Commission's Advisory Committee. The industry representatives expressed their appreciation to Mr. Royal upon his coming retirement as Director after more than 22 years service.

### 1970 REGULATIONS

Recommendations for regulations governing the 1970 sockeye salmon fishery in Convention waters were adopted at a meeting of the Commission held on February 3, 1970 and submitted to the two national governments for approval and to the State of Washington for implementation on February 20, 1970. The recommendations for Canadian Convention waters were implemented by the Government of Canada by an Order-in-Council dated May 19, 1970 and for United States Convention waters by an Order of the Director of the Washington State Department of Fisheries on May 16, 1970.

The recommendations of the Commission were as follows:

#### **Canadian Convention Waters**

"The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation and extension of the Sockeye Salmon Fisheries of the Fraser River System, signed at Washington on the 26th day of May, 1930, as amended by the Pink Salmon Protocol signed at Ottawa on the 28th day of December, 1956, hereby recommends that regulations to the following effect, in the interests of such fisheries, be adopted by Order-in-Council as amendments to the Special Fishery Regulations for British Columbia for the season of 1970, under authority of the Fisheries Act, namely:

1. (1) No person shall fish for sockeye or pink salmon in the waters of the southerly portion of District No. 3 embraced in that portion of Area 20 lying westerly of a straight line drawn true south from Sheringham Point Lighthouse to the International Boundary line with purse seines:

(a) From the 21st day of June, 1970 to the 25th day of July, 1970, both dates inclusive; and

(b) From the 26th day of July, 1970 to the 29th day of August, 1970, both dates inclusive, except from six o'clock in the forenoon to six o'clock in the afternoon of Monday, Tuesday and Wednesday of each week; and



(c) From the 30th day of August, 1970 to the 12th day of September, 1970, both dates inclusive, except from seven o'clock in the forenoon to seven o'clock in the afternoon of Monday, Tuesday and Wednesday of each week.

(2) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets:

(a) From the 21st day of June, 1970 to the 25th day of July, 1970, both dates inclusive; and

(b) From the 26th day of July, 1970 to the 29th day of August, 1970, both dates inclusive, except from

(i) six o'clock in the afternoon of Sunday to six o'clock forenoon of Monday; and

(ii) six o'clock in the afternoon of Monday to six o'clock in the forenoon of Tuesday; and

(iii) six o'clock in the afternoon of Tuesday to six o'clock in the forenoon of Wednesday of each week; and

(c) From the 30th day of August, 1970 to the 12th day of September, 1970, both dates inclusive, except from

(i) seven o'clock in the afternoon of Sunday to seven o'clock in the forenoon of Monday; and

(ii) seven o'clock in the afternoon of Monday to seven o'clock in the forenoon of Tuesday; and

(iii) seven o'clock in the afternoon of Tuesday to seven o'clock in the forenoon of Wednesday of each week.

2. No person shall fish for sockeye or pink salmon in the waters of the southerly portion of District No. 3 embraced in Areas 17 and 18 and in the waters of District No. 1 by means of nets:

(a) From the 28th day of June, 1970 to the 11th day of July, 1970, both dates inclusive, except for those sockeye or pink salmon taken in gill nets having mesh of not less than 8½ inches extension measure as authorized for the taking of chinook salmon by the Director of Fisheries for the Pacific Region and pursuant to the provisions of the British Columbia Fishery Regulations; and

(b) From the 12th day of July, 1970 to the 18th day of July, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday; and

(c) From the 19th day of July, 1970 to the 8th day of August, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Wednesday of each week; and

(d) From the 9th day of August, 1970 to the 29th day of August, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week; and

(e) From the 30th day of August, 1970 to the 5th day of September, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday in the following described waters:

(i) In the main Fraser River upstream to the Canadian Pacific Railway Bridge from a straight line projected north and south magnetic through the Woodward's Training Wall West Light near Steveston; and

(ii) In Canoe Pass upstream from a line projected north and south magnetic through Brunswick Cannery; and

(iii) In the Middle and North Arms upstream from Oak Street Bridge; and

(f) From the 6th day of September, 1970 to the 12th day of September, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday; and

(g) From the 13th day of September, 1970 to the 19th day of September, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday in those waters described in subsection (e) of this section; and

(h) From the 20th day of September, 1970 to the 26th day of September, 1970, both dates inclusive; and

(i) From the 27th day of September, 1970 to the 10th day of October, 1970, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week.

3. No person shall fish for sockeye or pink salmon, except by angling or trolling for the purpose of personal consumption and not for sale or barter, in the Convention waters of Canada (the waters of Howe Sound excepted) lying easterly and inside of a straight line projected from Gower Point at the westerly entrance to Howe Sound to Thrasher Rock Light, thence in a straight line to Salamanca Point on the southerly end of Galiano Island, thence in a straight line to East Point on Saturna Island, thence in a straight line towards Point Roberts Light to the intersection with the International Boundary line, thence following the International Boundary line to its intersection with the mainland from the 16th day of August, 1970 to the 30th day of September, 1970, both dates inclusive, except at the times that net fishing other than with chinook salmon nets may be permitted within that area.

All times hereinbefore mentioned shall be Pacific Daylight Saving Time."

### **United States Convention Waters**

"The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation and extension of the Sockeye Salmon Fisheries of the Fraser River System, signed at Washington on the 26th day of May, 1930, as amended by the Pink Salmon Protocol signed at Ottawa on the 28th day of December, 1956, hereby recommends to the United States Government that regulations to the following effect, in the interests of such fisheries, be adopted for the year 1970 and that an approved copy of said regulations be forwarded to the Director of Fisheries of the State of Washington for implementation by virtue of authority in him vested by Section 6 of Chapter 112 of the Laws of the State of Washington of 1949, namely:

1. (1) No person shall fish for sockeye or pink salmon in the Convention waters of the United States of America lying westerly of a straight line drawn from Angeles Point in the State of Washington across Race Rocks to William Head in the Province of British Columbia with purse seines:

(a) From the 21st day of June, 1970 to the 25th day of July, 1970, both dates inclusive; and

(b) From the 26th day of July, 1970 to the 15th day of August, 1970, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday, Tuesday and Wednesday of each week; and

(c) From the 16th day of August, 1970 to the 12th day of September, 1970, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday, Tuesday and Wednesday of each week.

(2) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets:

(a) From the 21st day of June, 1970 to the 25th day of July, 1970, both dates inclusive; and



(b) From the 26th day of July, 1970 to the 1st day of August, 1970 and from the 9th day of August, 1970 to the 15th day of August, 1970, all dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday, from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday, and from seven o'clock in the afternoon of Wednesday to half past nine o'clock in the forenoon of Thursday of each week; and

(c) From the 2nd day of August, 1970 to the 8th day of August, 1970, both dates inclusive, except from seven o'clock in the afternoon of Sunday to half past nine o'clock in the forenoon of Monday, from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday, and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday; and

(d) From the 16th day of August, 1970 to the 22nd day of August, 1970 and from the 30th day of August, 1970 to the 5th day of September, 1970, all dates inclusive, except from six o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday, from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday, and from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday of each week; and

(e) From the 23rd day of August, 1970 to the 29th day of August, 1970 and from the 6th day of September, 1970 to the 12th day of September, 1970, all dates inclusive, except from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday, from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday, and from six o'clock in the afternoon of Wednesday to nine o'clock in the forenoon of Thursday of each week.

2. (1) No person shall fish for sockeye or pink salmon in the Convention waters of the United States of America lying easterly of a straight line drawn from Angeles Point in the State of Washington across Race Rocks to William Head in the Province of British Columbia with nets from the 28th day of June, 1970 to the 11th day of July, 1970, both dates inclusive.

(2) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) of this section lying inside of a line projected from Point Partridge to Smith Island Light to Lawson Reef Light to West Point on Whidbey Island with nets from the 12th day of July, 1970 to the 25th day of July, 1970, both dates inclusive.

(3) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) lying northerly and westerly of a straight line drawn from Iwersen's Dock on Point Roberts in the State of Washington to the flashing white light on Georgina Point at the entrance to Active Pass in the Province of British Columbia with nets from the 30th day of August, 1970 to the 5th day of September, 1970 and from the 13th day of September, 1970 to the 3rd day of October, 1970, all dates inclusive.

(4) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) lying westerly of a straight line drawn true south from the southeast tip of Point Roberts in the State of Washington (otherwise known as Lily Point) to the International Boundary line with nets from the 6th day of September, 1970 to the 12th day of September, 1970, both dates inclusive.

(5) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets:

(a) From the 12th day of July, 1970 to the 18th day of July, 1970, both dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday, and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday; and

(b) From the 19th day of July, 1970 to the 25th day of July, 1970 and from the 2nd day of August, 1970 to the 8th day of August, 1970, all dates inclusive, except from seven o'clock in the afternoon of Sunday to half past nine o'clock in the forenoon of Monday, from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday of each week; and

(c) From the 26th day of July, 1970 to the 1st day of August, 1970 and from the 9th day of August, 1970 to the 15th day of August, 1970, all dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the fore-

noon of Tuesday, from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday, and from seven o'clock in the afternoon of Wednesday to half past nine o'clock in the forenoon of Thursday of each week; and

(d) From the 16th day of August, 1970 to the 22nd day of August, 1970, from the 30th day of August, 1970 to the 5th day of September, 1970, from the 13th day of September, 1970 to the 19th day of September, 1970 and from the 27th day of September, 1970 to the 3rd day of October, 1970, all dates inclusive, except from six o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday, from six o'clock in the afternoon of Monday, to nine o'clock in the forenoon of Tuesday, and from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday of each week; and

(e) From the 23rd day of August, 1970 to the 29th day of August, 1970, from the 6th day of September, 1970 to the 12th day of September, 1970 and from the 20th day of September, 1970 to the 26th day of September, 1970, all dates inclusive, except from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday, from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday, and from six o'clock in the afternoon of Wednesday to nine o'clock in the forenoon of Thursday of each week.

(6) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with purse seines:

(a) From the 12th day of July, 1970 to the 18th day of July, 1970, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday and Tuesday; and

(b) From the 19th day of July, 1970 to the 15th day of August, 1970, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday, Tuesday and Wednesday of each week; and

(c) From the 16th day of August, 1970 to the 3rd day of October, 1970, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday, Tuesday and Wednesday of each week.

(7) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with reef nets:

(a) From the 12th day of July, 1970 to the 18th day of July, 1970, both dates inclusive, except from

(i) twelve o'clock (noon) Sunday to half past nine o'clock in the afternoon of Sunday; and

(ii) five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday; and

(iii) five o'clock in the forenoon of Tuesday to twelve o'clock (noon) Tuesday; and

(b) From the 19th day of July, 1970 to the 15th day of August, 1970, both dates inclusive, except from

(i) twelve o'clock (noon) Sunday to half past nine o'clock in the afternoon of Sunday; and

(ii) five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday and Tuesday; and

(iii) five o'clock in the forenoon of Wednesday to twelve o'clock (noon) Wednesday of each week; and

(c) From the 16th day of August, 1970 to the 3rd day of October, 1970, both dates inclusive, except from

(i) twelve o'clock (noon) Sunday to nine o'clock in the afternoon of Sunday; and

(ii) five o'clock in the forenoon to nine o'clock in the afternoon of Monday and Tuesday; and

(iii) five o'clock in the forenoon of Wednesday to twelve o'clock (noon) Wednesday of each week.



3. (1) The foregoing recommended regulations shall not apply to the following United States Convention waters:

(a) State Fishing Area No. 7 including all Convention waters known as Bellingham Bay lying inside of a line extending from Point Frances through the Post Point Bell Buoy to the mainland, and

(b) That portion of State Fishing Area No. 3 lying easterly and inside of a line projected from Carter Point on Lummi Island to the most northerly tip of Vendovi Island, thence to Clark Point on Guemes Island including the waters of Samish Bay, and

(c) Preserves previously established by the Director of Fisheries of the State of Washington for the protection of other species of food fish.

All times hereinbefore mentioned shall be Pacific Daylight Saving Time."

### Emergency Amendments

In order to provide for adequate racial escapements of Fraser River sockeye salmon and for an equitable share of the season's catch by the fishermen of the United States and Canada, the approved regulations as detailed above were later amended on recommendation of the Commission. A detailed list of the regulatory amendments is as follows:

July 2, 1970—As the result of a meeting held on June 29 to consider a brief submitted by the Makah Indian Tribe of Neah Bay, Washington, the Commission recommended the United States Convention waters lying westerly of Angeles Point be open to fishing on July 12 instead of July 25 as originally scheduled. Fishing times in these waters would be under the same regulations as those already approved for United States Convention waters lying easterly of Angeles Point.

July 21, 1970—Because of increased catches of Chilko sockeye by the test fishing boat in Juan de Fuca Strait, and in view of the small fleet operating in United States Convention waters, the Commission recommended an additional 24 hours fishing in all United States Convention waters for the current week.

July 31, 1970—Since the Fraser River sockeye escapement as of July 30 was below expectations and a minimum escapement of 300,000 Chilko and Stellako sockeye would be needed during the next two weeks, the Commission recommended the following fishing times for the week commencing August 2: 1. All Canadian Convention waters lying westerly of William Head open as originally scheduled but limited to two days fishing; 2. The opening of all Canadian Convention waters lying easterly of William Head be delayed for 24 hours with fishing being restricted to one day commencing at 8:00 a.m. Tuesday, August 4; 3. All United States Convention waters open as scheduled but limited to two days fishing.

August 4, 1970—In the interest of equal division of the catch the Commission recommended that an additional 24 hours fishing be granted for all United States Convention waters for the current week restoring fishing time in these waters to a total of three days as originally scheduled.

August 7, 1970—In order to obtain a more equitable division of the catch and increase the escapement the Commission made the following recommendations for the week commencing August 9: 1. Net fishing in Canadian Convention waters lying westerly of William Head be restricted to two days, with a 24-hour delay in the scheduled opening time; 2. Fishing by trollers in Canadian Convention waters lying westerly of William Head be restricted to the same fishing time as the net fishery in that area; 3. Fishing in Canadian Convention waters lying easterly of William Head be permitted for one day as previously scheduled but the opening time be delayed by 24 hours to commence 8:00 a.m. Tuesday, August 11; 4. Starting date of the originally scheduled troll restriction for the waters adjacent to the Fraser River be advanced one week to August 9 to protect delaying sockeye.

August 12, 1970—In an attempt to reduce the serious deficit in the United States catch the Commission recommended granting an additional 48 hours fishing in all United States Convention waters for the current week making a total of five days fishing. The Commission also recommended that because the required escapements of Chilko and Stellako sockeye had not been achieved, the opening of Canadian Convention waters lying easterly of William Head be delayed 24 hours with fishing for a 24-hour period to commence at 8:00 a.m. Tuesday, August 18.

August 14, 1970—In the interest of the division of catch between the fishermen of the United States and Canada the Commission recommended that the scheduled opening of fishing in all United States Convention waters for the week commencing August 16 be advanced 24 hours to Saturday, August 15 for reef nets and gill nets, and to Sunday, August 16 for purse seines.

August 18, 1970—In order to permit a greater escapement of sockeye through Juan de Fuca Strait and to aid in the division of catch the Commission recommended that fishing be restricted to two days in Canadian Convention waters lying westerly of William Head for the current week. Also, an additional 24 hours fishing was recommended for all United States Convention waters making a total of four days fishing for the current week.



August 21, 1970—Available evidence indicated that the Adams River sockeye run might be smaller than anticipated and that restricted fishing times were required. Therefore the Commission recommended the following regulatory changes: 1. Fishing in all United States Convention waters be postponed until 12:00 noon Wednesday, August 26 for reef nets, until 5:00 a.m. Thursday, August 27 for purse seines and until 6:00 p.m. Thursday, August 27 for gill nets, with fishing restricted to two days; 2. All Canadian Convention waters lying westerly of William Head be restricted to two days fishing commencing 6:00 p.m. Wednesday, August 26 for gill nets and 6:00 a.m. Thursday, August 27 for purse seines; 3. All Canadian Convention waters lying easterly of William Head be closed to fishing except for 24 hours commencing 8:00 a.m. Thursday, August 27 in those waters lying inside and easterly of a line extending from Point Grey to Point Grey Buoy thence to the light on the western end of the North Arm Jetty, thence to Sand Heads Light, thence to Canoe Pass Buoy, thence to the light on the western end of Tsawwassen Causeway and thence toward West Point Roberts Light to the International Boundary line, commonly known as the "Blue Line".

August 28, 1970—After reviewing all the current information pertaining to the Adams River sockeye run the Commission made the following recommendations in the interest of equitable division of the allowable catch and adequate escapement: 1. Effective August 30 the Commission would relinquish control in all Convention waters lying westerly of the Angeles Point-William Head line; 2. All United States Convention waters lying easterly of the Angeles Point line be closed for the week commencing August 30. Regulatory control of these waters to be relinquished September 6 with the exception of those waters lying westerly of the Lily Point line; 3. The Canadian Convention waters encompassed in Areas 17, 18 and District 1 be closed for the week commencing August 30 except for 24 hours fishing commencing 8:00 a.m. Wednesday, September 2 in the waters of District 1 including the Fraser River.

September 3, 1970—In the interest of escapement and to achieve equality in the season's catch between the fishermen of the two countries the Commission recommended that all Canadian Convention waters lying easterly of William Head be closed to fishing, except for 24 hours commencing 8:00 a.m. Tuesday, September 8 in those waters lying upstream from the Brunswick Cannery-Oak Street Bridge boundary.

September 9, 1970—The Commission reviewed the current status of the delaying Adams River population in the Gulf of Georgia and, because of the anticipated upstream movement of these fish

in volume by September 13-14, the Commission recommended that Canadian Convention waters lying within Areas 17, 18 and District 1 be closed effective September 12 until adequate escapement of Adams fish was obtained.

September 10, 1970—Observations and test fishing by the Commission's staff in the lower reaches of the Fraser River on September 10 indicated that very few Adams River sockeye were entering the Fraser River. On the basis of this information the Commission recommended a 24-hour fishery in those Canadian Convention waters lying upstream from the Brunswick Cannery-Oak Street Bridge boundary commencing 8:00 a.m. Friday, September 11 for the purpose of harvesting late migrating sockeye populations other than the Adams River run, with the closure announced September 9 to become effective 8:00 a.m. Saturday, September 12.

September 25, 1970—After reviewing the current status of the Adams River sockeye run currently moving up the Fraser River the Commission made the following recommendations: 1. Effective September 27 the Commission would relinquish control of all United States Convention waters lying westerly of the Lily Point line except for those waters lying westerly and northerly of the Iwersen Dock-Active Pass line. The Iwersen Dock line would remain in effect until October 4; 2. Fishing would be permitted in those Canadian Convention waters lying upstream from the Brunswick Cannery-Oak Street Bridge boundary for a 12-hour period from 7:00 a.m. to 7:00 p.m. Monday, September 28.

October 6, 1970—In order to harvest the late running portion of the Adams River sockeye run, considered to be undesirable spawners, the Commission recommended that all Canadian Convention waters lying easterly of William Head be opened to fishing for 24 hours commencing 8:00 a.m. Thursday, October 8 and that regulatory control be relinquished in these waters effective October 11.

## **SOCKEYE SALMON REPORT**

### **The Fishery**

The total 1970 Fraser River sockeye run, estimated at 6,131,000 fish, was 90.2% of the predicted run of 6,800,000. The number entering Convention waters totaled 4,991,000, of which 2,891,988 were caught commercially, 151,123 were taken by the Indian fishery, and 1,948,171 were recorded on the spawning grounds (see Tables I to VI in Appendix). The estimated catch of Fraser River sockeye in Johnstone Straits was 1,000,000 fish which represents 24.8% of the total commercial catch of Fraser sockeye in all areas, and 16.3% of the total run. The latter figure may be compared with catches of 4.03% of the total run in 1962 and 12.46% in 1966, the preceding two cycle years.



An intrusion of warm water along the West Coast of Vancouver Island was recorded early in the fishing season by the Fisheries Research Board Pacific Biological Station. Since thermal conditions in the landfall area of Fraser River sockeye are known to affect their approach characteristics, an increase in the number of sockeye approaching the Fraser River from the north was not surprising. However, this situation had not been expected in 1970 since it was not consistent with an inferred relationship between warm water intrusions and the sunspot cycle. The northerly diversion of sockeye, combined with a substantial increase in the high seas troll catch, adversely affected the net catch in Convention waters by reducing the number of fish available there.

While the total 1970 run approached the number predicted in advance of the fishing season, the summer run consisting mainly of Chilko and Stellako sockeye was only approximately 50% of that anticipated. The failure of these populations to return in expected numbers remains unexplained. The early season runs, including Early Stuart, approached expectations and the late run to Adams River was about 500,000 fish larger than anticipated. The Adams River population totaled approximately 4,000,000 sockeye or 65.2% of the total season's run. This run has increased in size each cycle year since the small run of 1962 and it is this increase which made the 1970 catch the largest for this cycle since the outstanding run in 1958.

The unusual migration characteristics of the 1970 run had a major influence on the fishery. The intrusion of warm water along Vancouver Island and the related increase in the number of fish approaching from the north has already been discussed. In addition, for the first time on record, the summer sockeye runs failed to appear in the Canadian high seas troll catches, yet they arrived as expected in the Juan de Fuca Strait net fishery where substantial numbers were caught. It cannot be determined whether these fish passed outside the troll fishery and entered Juan de Fuca Strait from the southwest, or whether environmental conditions prevented their capture by the troll fleet. By contrast, Adams River sockeye were taken in substantial numbers, it being estimated that Canadian trollers caught over 200,000 of these fish in 1970 compared with only 30,000 in the cycle year of 1966.

Normally, catches by the Canadian net fishery in Juan de Fuca Strait can be used to evaluate racial run size as the season progresses, based on the established relationship between the catch in this area and subsequent catches in the Salmon Banks area of United States Convention waters. Later, catches by the Fraser River gill net fleet are used to measure the efficiency of the United States fishing fleet which varies significantly from year to year. The 1970 catches in Juan de Fuca Strait indicated that the individual runs were larger than expected but the catch in the Salmon Banks area failed to respond accordingly. Additional fishing time was granted the United States fleet, based on the assumption that its efficiency was below average as has occurred occasionally in previous years. However, the Fraser River catch and the weekly escapement indicated a normal efficiency in the Salmon Banks-Point Roberts area showing that any vagary in the fisheries was occurring in Juan de Fuca Strait. It soon became evident that the Canadian net fishery was capturing milling rather than migrating sockeye in Juan de Fuca Strait, resulting in far greater catches than normal. Evidently this same situation occurred only once before in 1934.

Although the Juan de Fuca area was restricted to two days fishing each week, it was difficult to achieve an equitable division of the catch, particularly when Canadian fishermen also made an unprecedented one day catch of sockeye in Georgia Strait on September 2. Canadian fishermen harvested an excess of 191,554 sockeye over the catch taken by United States fishermen or 53.3% of the total Convention waters catch compared with 46.7% by United States fishermen.

Distribution of the 1970 catch by the several fishing gears was very similar in United States Convention waters to that of the brood year; purse seines harvested 57.7% (58.6% in 1966), gill nets took 37.4% (37.1%) and reef nets 4.9% (4.3%).

The percentage of the total Canadian sockeye catch taken in Juan de Fuca Strait and the high seas area of Convention waters increased significantly in 1970 to 63.1% compared with 53.2% in 1966. This large Canadian catch was caused by the troll fleet taking the highest percentage of the total catch ever recorded and the large net catches of milling fish at the entrance of Juan de Fuca Strait. In contrast, the Fraser River fishermen harvested 567,244 sockeye compared with 627,987 in the brood year.

| <i>Per Cent of Canadian Sockeye Catch Taken in the High Seas and Juan de Fuca Strait</i> |                 | <i>Per Cent of Canadian Sockeye Catch Taken by Purse Seines in Juan de Fuca Strait*</i> |                 | <i>Per Cent of Canadian Sockeye Catch Taken by Gill Nets in Juan de Fuca Strait*</i> |                 |
|------------------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------|-----------------|
| <i>Cycle Year</i>                                                                        | <i>Per Cent</i> | <i>Maximum P.S. Units</i>                                                               | <i>Per Cent</i> | <i>Maximum G.N. Units</i>                                                            | <i>Per Cent</i> |
| 1970                                                                                     | 63.13           | 87                                                                                      | 31.59           | 492                                                                                  | 27.84           |
| 1966                                                                                     | 53.24           | 77                                                                                      | 30.53           | 287                                                                                  | 22.00           |
| 1962                                                                                     | 35.94           | 74                                                                                      | 19.97           | 311                                                                                  | 15.77           |
| 1958                                                                                     | 54.14           | 121                                                                                     | 45.56           | 463                                                                                  | 8.27            |
| 1954                                                                                     | 36.42           | 139                                                                                     | 33.68           | 101                                                                                  | 1.86            |
| 1950                                                                                     | 32.41           | 91                                                                                      | 27.44           | 39                                                                                   | 0.53            |
| 1946                                                                                     | 13.49           | 84                                                                                      | 12.52           | 9                                                                                    | 0.08            |

\* Troll catches not listed.

The average weight of four-year-old sockeye was 6.13 pounds, significantly less than the cycle average of 6.41 pounds.

### Escapement

The net escapement of 1,948,171 sockeye represented 39.0% of the 1970 run to Convention waters and 31.8% of the calculated Fraser River run. This escapement was approximately the same as that in 1966, the brood year, in total number of spawners, but there was considerable variation in escapement of individual populations (Table VI). Certain escapements in 1970 were quite satisfactory while others were substantially below the number required for adequate brood stock.



The first run of the season, destined for the Stuart Lake system, appeared in numbers approaching those anticipated and benefitted substantially from closures of both the commercial and Indian fisheries. This year's escapement of 34,566 Early Stuart sockeye was more than three times that of the brood year and equaled or exceeded all recorded escapements on this cycle except 1950. Favorable water levels prevailed in the Fraser River system during upstream migration and spawning of these fish. Similar favorable water conditions combined with severe restrictions of the fishery have increased recent escapements to the level that a moderate fishery on this population can be anticipated in those future cycle years when anticipated survival conditions justify such action.

The escapement of 1,341 spawners to the Bowron River system was unsatisfactory even for a small off-year cycle.

The escapement of 4,764 spawners to Nadina River was considerably larger than for any previous cycle year since at least 1917. Most were late run sockeye that spawn in a limited area just below the falls at the outlet of Nadina Lake. It is this population which will benefit substantially from the Nadina spawning channel now under construction (Figure 1).

The escapements to Stellako, Seymour, Raft, Chilko and Horsefly Rivers were reduced considerably from the brood year, primarily because the size of these runs was only 50% of expectation while the percentage taken by the fishery remained similar in both years. Normally, additional restrictions would have been placed on the fishery to compensate for the smaller runs in 1970. However, the Juan de Fuca Strait fishery, operating on milling fish, masked the small run size until it was too late to enact compensating regulations to obtain the desired number of spawners.

The decline in the Stellako escapement to 45,876 spawners was particularly disappointing since this has been the dominant cycle year of each quadrennial period for some time. Even though spawning conditions in Stellako River were favourable, the failure to secure a satisfactory number of spawners may prevent the 1970 cycle from remaining the largest of the quadrennial cycle.

The escapement of 1,502,681 sockeye to the Adams River area approached the estimated maximum number of spawners required for this system, although escapements were substantially larger in the earlier brood years of 1942, 1946, 1954 and 1958. With a more equal distribution of flow provided between the right and left bank channels in Adams River, as illustrated in the 1969 Annual Report, spawning and incubation conditions appear improved and it is believed that the egg-to-fry survival rate will be increased. The importance of maintaining a satisfactory escapement of this sockeye population is evident in the fact that this run produced 65.3% of the total 1970 Fraser sockeye run.

The dominant spawning escapement to Adams River has become famous as an educational and tourist attraction. Every fourth year on the 1970 cycle year over a million brilliantly colored sockeye spawn in the crystalline waters of Adams River blended with the autumnal coloration of the adjacent cottonwood and aspen trees. All of this together with brisk, clear fall weather and good access roads

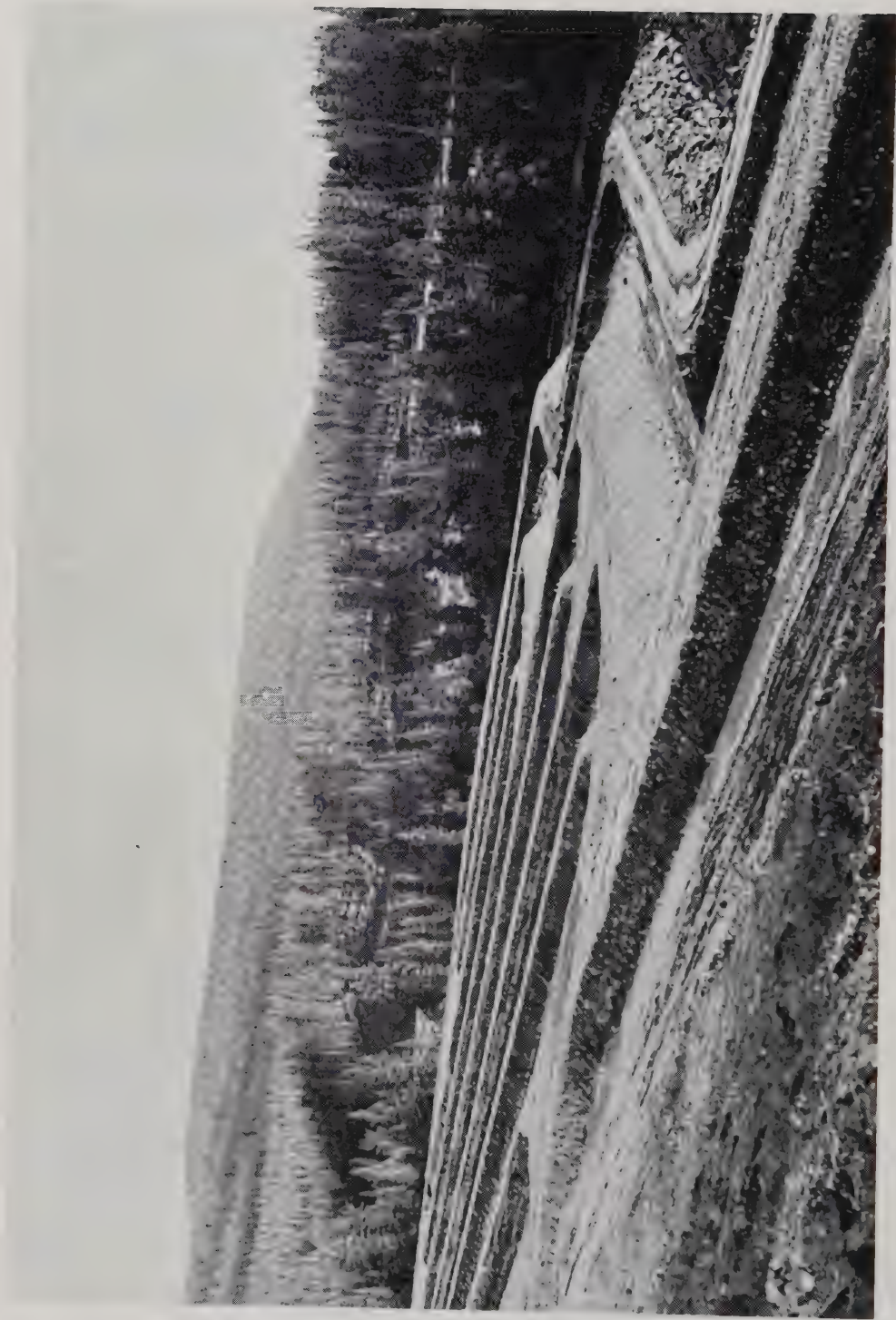


FIGURE 1—Nadina spawning channel under construction.



combine to make this a most spectacular sight. In 1970, fisheries agencies and organizations in British Columbia again presented the "Salute to the Sockeye Celebration" consisting of the construction of viewing sites with connecting trails, educational displays and other items of interest including fish cooking demonstrations and educational movies relating to the fisheries resource. Over 100,000 people, including many busloads of school children, visited the spawning area and display grounds during the month of October when spawning was under way. The attendance alone illustrates the tremendous public interest in this spectacular.

All of the sockeye populations produced in the lower river spawning grounds declined significantly from those produced in the brood year and the resulting escapements declined proportionately. The reduction in these runs was caused apparently by a low smolt-to-adult survival rate rather than by poor spawning, incubation or lake rearing environments. For instance, although over 2,100,000 smolts emigrated from Cultus Lake, the adult return was estimated at about 45,000 fish in 1970, representing a smolt-to-adult survival rate of only 2%. This may be compared with the Chilko smolt-to-adult survival rates which have dropped below 3% only twice in the past 18 years and have reached as high as 22%.

While the Adams River run showed a sizeable increase over those of the preceding two cycle years the Portage Creek population, transplanted initially from Adams River, declined drastically in 1970 and the outlook for the 1971 run is equally poor. This population built up gradually, beginning with a small return from a planting of eyed Adams River eggs in 1950 and reaching a spawning population totaling 31,844 sockeye in 1966. The 1970 escapement was down to 3,901 fish. Field investigations revealed no mining or industrial effluent, and no stream alteration which could explain the serious decline in the 1970 run or the similar decline expected in 1971. Determining the causative factor is further complicated by the sustained production of the Gates Creek run within the same watershed.

### **Rehabilitation**

The fry population emerging from Weaver Creek channel in the spring of 1970 was the largest in the 5 years since the channel began operation in 1965. A record 32,600,000 fry were produced by the 17,089 adult sockeye which spawned in the channel in 1969. This large spawning population was approximately three times the size of any previous channel stocking. The egg-to-fry survival rate of 89.5% was also the highest recorded here, indicating that the initial design of the channel water supply and settling ponds has been effective, allowing continued high production rates without requiring extensive cleaning of the gravel.

The Commission has established that spawning and incubation channels represent a sound investment justifying an immediate and expanded program of development. However, since potential production from channels is so large, care must be used in managing a facility of this type. The potential of channel production is exemplified by the 1970 Weaver channel population of fry, which was 13 times the previous long-term average yearly production from Weaver Creek

natural spawning grounds. To put this in another way, it would have required an average of 205,000 spawners in Chilko River to produce the number of fry originating from only 17,000 spawners in Weaver channel.

One consideration in channel management must therefore be to evaluate the impact of increased fry populations on the capacity of the related lake rearing area. The 1970 fry production from Weaver channel, when combined with the estimated number of naturally produced fry in the system, formed a total of about 55,000,000 fry, approaching the calculated rearing capacity of Harrison Lake.

A second consideration in channel management concerns the eventual possibility of producing large numbers of fry *every* year in races which historically have shown major annual fluctuations in run size on a quadrennial cycle. If the release of large numbers of fry each year should prove to lower production by interfering with this cyclic dominance, better production rates in some areas may be obtained by operating the channel in only certain years of each four-year cycle. In this event, channel operation will continue to be profitable. Operating costs could be reduced and capital costs of channel construction will have already been recovered, as evidenced by the recent single year of adult returns to Weaver channel valued at \$191,000 which reduced the capital cost of the project from \$275,000 to a balance of only \$84,000. The foregoing considerations, among others, indicate the continuing studies required in order to ensure maximum sustained production from channels.

The Weaver Creek adult run returning in 1970 was substantially smaller than that of the 1966 brood year and of the record 1969 run. The 1970 run to Upper Pitt River, supported mainly by an incubation channel, likewise was substantially smaller than that of the brood year. This reduction in run size was common to all runs of the lower Fraser River tributaries including several spawning runs supported solely by natural reproduction such as Cultus Lake and Harrison River. Egg-to-fry survival rate for this brood had been high at both the Weaver and Upper Pitt channels but as noted previously, monitoring of the Cultus race indicated a very low smolt-to-adult survival rate. Evidently the sparse runs to the entire lower Fraser River district were caused by a low smolt-to-adult survival rate, whatever the reason.

The adult returns in 1970 were of particular interest since several streams had previously received eyed-egg plants on this cycle. Although many of the experiments involving the transplantation of eyed eggs or advanced fry to barren streams failed to return any fish at all, there have been a few outstanding successes which have repaid the modest cost of the entire operation. Since Scotch Creek did not have a native sockeye run on the cycle year of the dominant Adams River run, 1,023,000 eyed Seymour eggs were planted in this stream in 1962. In 1966, 459 spawners returned to Scotch Creek and spawned in late August, the same timing as the native run which occurs in the 1961-1965 cycle year. Considering the commercial and Indian harvest of these fish the survival from this transplant was considered satisfactory. The important question was whether the new brood stock would be self-sustaining, hence the return of 359 sockeye in the 1970 cycle year was most satisfying, particularly when all similarly timed runs in 1970 suffered from a low smolt-to-adult survival rate.



A similar transplant of 1,396,000 eyed sockeye eggs of Adams River origin to Middle Shuswap River was made in 1954, the cycle year of the dominant Adams run. A total of 499 sockeye returned to this previously barren stream in 1958. These fish spawned naturally and this population was not stimulated further by additional transplantations. An escapement of 457 spawners returned in 1962, 1,872 in 1966 and 4,559 in 1970. This consistent cyclical increase in the size of the Middle Shuswap run is independent of the fluctuations in population size of the donor population and evidently it has become a self-sustaining run.

The most successful transplant in terms of a self-sustaining run resulted from planting Adams River eggs and fingerlings from the 1950 dominant cycle in Portage Creek, tributary to the Seton-Anderson Lake system. A total of 3,505 spawning fish were recorded in Portage Creek in 1954, and the cyclical return increased consistently thereafter until in 1966 a total of 31,844 spawners were observed. The decline in the 1970 escapement was discussed earlier, but the naturally produced increase for three consecutive cycle years presents strong evidence that this run has been established on a permanent basis.

These variations in the success of rehabilitation programs indicate the need for more information concerning the factors affecting survival, particularly during the migrant stage of fry, advanced fry, and smolts. Modern fish cultural procedures practically guarantee production of large numbers of apparently viable fry by increasing the egg-to-fry survival rate. Modern rearing methods have demonstrated that the rearing of coho and chinook salmon and steelhead trout fry is a sound economic operation. However, adult returns from reared fish vary from year to year, between rearing stations in the same year, and even between lots released from the same rearing station. All of this demonstrates the need for additional information on factors affecting survival of cultured salmonids as well as for naturally produced fish. Since so many ecological conditions occur during the changing existence of anadromous fish, this is a particularly challenging problem.

## Research

In order to fulfill its terms of reference of protecting, preserving and extending the sockeye and pink salmon fisheries of the Fraser River, the Commission has established certain principles with regard to its investigational work. These principles are as follows:

1. To obtain and supply the necessary information to the respective governments when action may be required to protect the Fraser River sockeye and pink salmon fisheries.
2. To collect and collate the pertinent research data available from other agencies for application to the Commission's problems.
3. To initiate any new research that appears to be required and to stimulate other research groups to explore the same field in other areas.

The research efforts of the Commission have been divided into the three rather broad categories; management research, pollution, and physical engineering. This type of organization, operating under the above referenced principles, has proven

quite effective in dealing with the many fishery problems which accompany increasing watershed development, even though the size of the technical staff has been maintained at a relatively stable level for a number of years. A report of the staff's research operations for 1970 is submitted herewith.

A major part of the Commission's research activity on pink salmon is directed to measuring the varying environmental factors existing during freshwater and estuarial life history which appear to be related to eventual adult survival. Previous studies have indicated that although pink salmon fry production has been relatively constant, variation in subsequent survival has been the most important factor affecting the abundance of Fraser River pink salmon stocks. Research in 1970 was expanded towards obtaining more complete knowledge of the early sea life of the fry. Temperature, salinity, turbidity, and phytoplankton as well as fry abundance and their food supply were monitored regularly at 20 stations throughout southern Georgia Strait during the period of transition from fresh water to salt water. Under the conditions observed in 1970, the bulk of the pink salmon fry migrated northward from the river mouth, along the eastern shores of Georgia Strait. The small numbers of fry observed in the southern Gulf and San Juan Islands corroborated the evidence of the northward movement which is in contrast to the observations made in several preceding cycle years. The full value of these data will be realized when they are available for a sufficient number of years to establish a relationship to ultimate survival.

Research concerning sockeye populations of the Fraser system currently includes studies of all phases of the life history from spawning through freshwater development to smolt migration. These investigations, including studies of artificial culture, are described in the following paragraphs.

Coincident with the rehabilitation of certain major sockeye populations and the related increase in escapements, some populations have been plagued with serious prespawning mortalities. Losses are especially high among earlier than normal runs, among the early arrivals on the spawning grounds, and in years of warmer than normal water temperatures. Several studies over the last eight years have indicated possible methods of preventing this loss, but to date none have proven satisfactory. In 1970, experiments in chemical therapy were conducted on sockeye of the Chilko and Birkenhead runs using a nitrofurantoin drug developed in Japan. This drug had proved effective in controlling both columnaris and bacterial gill infections during salmonid rearing operations. Since the same pathogens are associated with prespawning mortality of sockeye, there was reason to believe that local use of this drug might control such losses. However, it was found that while the chemical was effective against *Chondrococcus columnaris* it did not prevent prespawning mortality. Further studies will be undertaken using a combination of controls, including temperature, in an attempt to reduce or prevent this economic disaster. In addition, studies are continuing on the physical and biochemical characteristics of adult spawners. Comparisons between populations or between differently timed segments of individual runs may indicate whether stress under specific circumstances contributes to premature mortality. Should prespawning mortality remain a problem, one alternative would be to construct artificial spawning channels with related temperature control facilities which could offset this loss by increasing fry production.

Probably the most complex study is that relating to the genetically controlled response of sockeye to their environment during the egg and fry stage. Earlier studies, which contributed to development of effective artificial spawning and incubation channels, included research on egg size, rate of development, timing of emergence, and fry migration behaviour and condition. Definite racial differences have now been established which will aid in the design of an improved program for rehabilitation or supplementation of runs. In addition, annual variation in egg size within the same population may indicate at least in part the survival potential of the fry.

Studies on the factors affecting fry emergence timing are now directed to the influence of temperature on the time required for yolk utilization and development during incubation. Although development is much accelerated at high temperatures, growth *per unit of temperature* is less than at lower temperatures. Recent studies of this "compensation" in rate of development at different temperatures indicate that each race examined to date appears to respond in the same general manner, although there is some difference between races in their ability to compensate for very low temperatures. All races compensated strongly to temperatures above 50°F and below 38°F. In another related study, results indicate that rate of development and time of fry emergence can be altered by several days by adjusting temperature at any time throughout the incubation period. These and other findings relate to the possible need for artificial temperature correction in spawning channels and provide a formula for doing so. They will also aid in properly assessing the effect of differences in temperature cycles between streams involved in egg transplants.

A study of the migratory behaviour of emergent fry, including those produced both naturally and artificially, shows that they follow a predetermined feeding migration. Insect larvae, usually Diptera, proved to be a major initial component in the fry's diet in both Harrison and Fraser Lakes. Once the availability of larvae declined the fry moved offshore and zooplankton formed the major part of their diet. As more data become available, the Commission can better assess the effect of food availability, growth, fry density, and timing on the fry-to-smolt survival in lakes and establish more precise formulae for lake stocking.

Present research is also directed toward understanding variations in the smolt-to-adult survival rate. Measurements of the Chilko sockeye population during several stages in its life history have revealed a smolt-to-adult survival rate varying from 1 to 22% over the past 20 years. While a high river flow at the time of smolt migration usually leads to a higher survival rate, it is not known if the flow itself is involved or whether some environmental condition related to flow affects the condition of the smolts. In order to understand this flow-smolt survival relationship better, a program has been undertaken to examine the condition of the smolt including physical measurements, fat analysis, screening for parasites and infections, seawater tolerance and stamina tests. Since various factors, notably temperature, have influenced the results of stamina measurements in field tests, correction formulae have now been developed from laboratory experiments and can be applied to previous and future data.



The Commission's research into the artificial culture of sockeye salmon has been carried out since 1949. The development of artificial spawning and incubation channels has been an important dividend from this effort. In addition to the incubation temperature studies described earlier, continuing investigations of channel incubation methods and substrate have been carried out to determine if egg-to-fry survival rates can be increased, and operational and maintenance costs can be decreased. Laboratory tests to date indicate that the gravel mixture now used in channels is superior to the use of larger stones both for survival rate and timing of fry emergence. Different approaches to egg planting have also been tested. Plants of green eggs gave adverse results with less than 60% of the eggs surviving to the fry emergent stage. However, plants of waterhardened eggs and eyed eggs both did equally well with a survival rate of about 90%.

Recent research on rearing sockeye from fry to the smolt stage has been seriously hampered by a viral infection, infectious hematopoietic necrosis (IHN). This infection appears to be the sole obstacle to a limited rearing operation for sockeye similar to the type which has been successful with coho and certain races of chinook salmon in the northwest states. Evidence obtained at the Western Fish Disease Laboratory in Seattle, Washington suggests the virus may be transmitted via the ovarian fluid from the female to its eggs rather than through the water supply. Further evidence suggests that at least some major sockeye populations reproducing above Hell's Gate may not be carriers, but that the virus may be localized in the sockeye populations inhabiting the lower watershed. The fact that Chilko Lake sockeye were successfully reared to smolts in 1970 using Cultus Lake water substantiates this hypothesis. All similar rearing experiments using Cultus Lake stock and Cultus Lake water were unsuccessful because of an outbreak of the infection. Recent experimental work at the Western Fish Disease Laboratory indicates that the virus can be killed by an organic iodine solution not harmful to eggs, hence all eggs collected from Cultus Lake sockeye in 1970 were treated with organic iodine to determine if this would permit a successful rearing experiment where all previous ones had failed. All other factors involved in the successful rearing of young sockeye including water supply, temperature, diet, feeding methods, pond design, and disease control have been defined. When the virus infection can be eliminated the Commission will be prepared to conduct a limited prototype experiment to measure smolt-to-adult survival rates of pond-reared fish and determine the value of this method for establishing new self-sustaining runs from transplants.

In the area of pollution study, recent research has been concerned with toxicity of heavy metals and pulp mill wastes. Mining operations and ore processing within the Fraser River watershed are controlled to prevent contamination of the adjacent waters but some heavy metals do reach the environment. Current research indicates that long-term exposure to copper during the egg-to-fry development period of sockeye and pink salmon causes mortality and abnormally slow yolk absorption at concentrations lower than those found lethal to fry and fingerlings. Other measurements show fingerling sockeye are stressed by copper at sublethal concentrations. Experiments involving mercury and cadmium indicate mercury to be far more toxic to developing sockeye embryos than to fingerlings, whereas the reverse is true for cadmium.

Although all kraft pulp mills operating on the Fraser River watershed have installed primary and secondary treatment of their wastes, this action alone does not guarantee that the treated wastes are not lethal when discharged into the receiving waters. Periodic monitoring of the toxicity of treated wastes reveals that occasionally the waste treatment systems fail to properly perform their function even though the biological oxygen demand of the waste has been reduced substantially. Materials passing through the treatment systems have been tested for identification and preliminary results indicate that residual toxicity may be related not only to operational problems but to the variable characteristics of the chip supply. This study directed towards treatment modification is being conducted in co-operation with Kamloops Pulp and Paper Company and the Forest Products Laboratory of the Canada Department of Fisheries and Forestry.

## 1970 PUBLICATIONS

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1969.
2. Progress Report Number 24.  
Effects of Decaying Bark on Incubating Salmon Eggs by J. A. Servizi, D. W. Martens and R. W. Gordon.
3. Administrative Report (restricted circulation).  
Proposed Artificial Spawning Channel for Nadina River Sockeye Salmon.



TABLE I  
SOCKEYE CATCH BY GEAR

| <i>United States Convention Waters</i> |                     |              |                 |                  |              |                 |                  |                 |                 |              |                 |
|----------------------------------------|---------------------|--------------|-----------------|------------------|--------------|-----------------|------------------|-----------------|-----------------|--------------|-----------------|
| <i>Year</i>                            | <i>Purse Seines</i> |              |                 | <i>Gill Nets</i> |              |                 | <i>Reef Nets</i> |                 |                 | <i>Troll</i> |                 |
|                                        | <i>Units</i>        | <i>Catch</i> | <i>Per Cent</i> | <i>Units</i>     | <i>Catch</i> | <i>Per Cent</i> | <i>Units</i>     | <i>Catch</i>    | <i>Per Cent</i> | <i>Catch</i> | <i>Per Cent</i> |
| 1970                                   | 191                 | 779,271      | 57.72           | 492              | 504,873      | 37.39           | 41               | 65,644          | 4.86            | 429          | 0.03            |
| 1966                                   | 187                 | 783,466      | 58.59           | 384              | 496,295      | 37.11           | 40               | 57,086          | 4.27            | 368          | 0.03            |
| 1962                                   | 225                 | 505,028      | 66.57           | 395              | 192,078      | 25.32           | 64               | 60,694          | 8.00            | 837          | 0.11            |
| 1958                                   | 368                 | 4,259,324    | 81.02           | 689              | 844,602      | 16.06           | 82               | 152,158         | 2.89            | 1,232        | 0.03            |
| <i>Total</i>                           |                     |              |                 |                  |              |                 |                  |                 |                 |              |                 |
|                                        |                     |              |                 |                  |              |                 |                  |                 |                 | 1,350,217    |                 |
|                                        |                     |              |                 |                  |              |                 |                  |                 |                 | 1,337,215    |                 |
|                                        |                     |              |                 |                  |              |                 |                  |                 |                 | 758,637      |                 |
|                                        |                     |              |                 |                  |              |                 |                  |                 |                 | 5,257,316    |                 |
| <i>Canadian Convention Waters</i>      |                     |              |                 |                  |              |                 |                  |                 |                 |              |                 |
| <i>Year</i>                            | <i>Purse Seines</i> |              |                 | <i>Gill Nets</i> |              |                 | <i>Troll</i>     |                 |                 | <i>Total</i> |                 |
|                                        | <i>Units</i>        | <i>Catch</i> | <i>Per Cent</i> | <i>Units</i>     | <i>Catch</i> | <i>Per Cent</i> | <i>Catch</i>     | <i>Per Cent</i> | <i>Catch</i>    | <i>Catch</i> | <i>Catch</i>    |
| 1970                                   | 87                  | 441,120      | 28.61           | 1,130            | 955,178      | 61.95           | 145,473          | 9.44            | 1,541,771       |              |                 |
| 1966                                   | 77                  | 405,585      | 30.04           | 1,484            | 922,831      | 68.53           | 21,708           | 1.61            | 1,350,154       |              |                 |
| 1962                                   | 74                  | 165,062      | 19.73           | 1,430            | 660,577      | 78.98           | 10,760           | 1.29            | 886,399         |              |                 |
| 1958                                   | 180                 | 2,541,592    | 48.49           | 2,275            | 2,680,914    | 51.15           | 4,870            | 0.09            | 5,241,617*      |              |                 |

\* Includes 14,241 trap caught sockeye.

NOTE: Gear counts represent the maximum number of units delivering sockeye on any single day.

TABLE II  
CYCLIC LANDINGS AND PACKS OF SOCKEYE  
FROM CONVENTION WATERS

|                                    | <i>United States</i> | <i>Canada</i> | <i>Total</i> |
|------------------------------------|----------------------|---------------|--------------|
| 1970                               |                      |               |              |
| Total Landings (No. Sockeye) ..... | 1,350,217            | 1,541,771     | 2,891,988    |
| Share in Fish .....                | 46.69%               | 53.31%        |              |
| Total Pack (48-lb Cases) .....     | 125,903              | 146,033*      | 271,936      |
| Share in Pack .....                | 46.30%               | 53.70%        |              |
| 1966                               |                      |               |              |
| Total Landings (No. Sockeye) ..... | 1,337,215            | 1,350,154     | 2,687,369    |
| Share in Fish .....                | 49.76%               | 50.24%        |              |
| Total Pack (48-lb Cases) .....     | 135,048              | 133,653**     | 268,701      |
| Share in Pack .....                | 50.26%               | 49.74%        |              |
| 1946-1970                          |                      |               |              |
| Total Landings (No. Sockeye) ..... | 40,197,624           | 39,659,848    | 79,857,472   |
| Share in Fish .....                | 50.34%               | 49.66%        |              |
| Total Pack (48-lb Cases) .....     | 3,518,692            | 3,448,897     | 6,967,589    |
| Share in Pack .....                | 50.50%               | 49.50%        |              |
| 1970 <i>Cycle Catch</i>            |                      |               |              |
| 1970 .....                         | 1,350,207            | 1,541,491     | 2,891,698    |
| 1966 .....                         | 1,337,215            | 1,350,154     | 2,687,369    |
| 1962 .....                         | 758,637              | 836,399       | 1,595,036    |
| 1958 .....                         | 5,257,316            | 5,241,617     | 10,498,933   |
| 1954 .....                         | 4,806,258            | 4,722,463     | 9,528,721    |
| 1950 .....                         | 1,220,893            | 894,469       | 2,115,362    |
| 1946 .....                         | 3,551,310            | 4,240,198     | 7,791,508    |
| 1942 .....                         | 2,935,192            | 5,047,599     | 7,982,791    |
| 1938 .....                         | 1,408,361            | 1,900,220     | 3,308,581    |
| 1934 .....                         | 3,590,058            | 1,430,300     | 5,020,358    |
| 1930 .....                         | 3,544,714            | 1,043,318     | 4,588,032    |
| 1926 .....                         | 469,900              | 912,566       | 1,382,466    |
| 1922 .....                         | 513,848              | 580,144       | 1,093,992    |
| 1918 .....                         | 569,094              | 242,275       | 811,369      |
| 1914 .....                         | 3,555,890            | 2,137,177     | 5,693,067    |
| 1910 .....                         | 2,765,726            | 1,690,091     | 4,455,817    |
| 1906 .....                         | 2,030,550            | 2,066,604     | 4,097,154    |
| 1902 .....                         | 4,001,717            | 3,177,538     | 7,179,255    |

\* Includes 156 cases packed in Canada from sockeye caught in United States Convention waters.

\*\* Includes 291 cases packed in Canada from sockeye caught in United States Convention waters.

NOTE: Pack figures include all sockeye landed even though some were sold fresh and frozen.

TABLE III  
DAILY CATCH OF SOCKEYE, 1958-1962-1966-1970 FROM UNITED STATES CONVENTION WATERS

| Date                       | JULY   |         |         |         | AUGUST    |         |           |           | SEPTEMBER |         |           |           |
|----------------------------|--------|---------|---------|---------|-----------|---------|-----------|-----------|-----------|---------|-----------|-----------|
|                            | 1958   | 1962    | 1966    | 1970    | 1958      | 1962    | 1966      | 1970      | 1958      | 1962    | 1966      | 1970      |
| 1                          |        |         |         |         |           | 25,695  | 131,250   |           | 170,818   |         |           | 31        |
| 2                          |        |         |         |         |           | 16,883  | 104,089   |           | 326,983   |         |           | 6         |
| 3                          |        |         |         |         |           |         |           | 79,718    |           |         |           |           |
| 4                          |        |         |         |         | 27,722    |         | 104,338   | 43,413    |           | 142     |           |           |
| 5                          |        |         |         |         | 17,753    |         | 56,763    | 897       |           |         |           |           |
| 6                          |        |         |         |         | 9,482     |         | 73,479    | 35,355    |           |         | 8,986     |           |
| 7                          |        |         |         |         |           | 32,790  |           |           | 255,742   | 553     |           |           |
| 8                          |        |         |         |         |           | 33,759  |           |           | 361,549   | 37,491  | 4,292     | 549       |
| 9                          |        |         |         |         |           | 42,145  |           |           | 278,614   | 17,758  | 9,196     | 301       |
| 10                         |        |         |         |         |           |         | 76,199    |           | 251,967   |         | 4,756     | 671       |
| 11                         |        |         |         |         |           |         | 66,840    |           | 270,105   |         |           | 275       |
| 12                         |        |         |         |         | 47,540    |         | 40,168    | 70,672    | 99,657    | 331     |           |           |
| 13                         |        |         |         |         | 52,692    |         | 45,066    | 55,718    | 83,545    | 4,921   |           |           |
| 14                         |        |         |         | 4,133   | 48,236    |         | 51,407    | 59,364    | 74,324    | 5,584   | 3,262     |           |
| 15                         |        |         |         | 1,716   |           | 41,499  | 26,894    | 67,530    | 71,025    | 542     | 980       |           |
| 16                         |        |         |         |         |           | 13,444  |           | 48,662    | 100,305   |         | 1,686     | 11,940    |
| 17                         |        |         |         |         |           |         | 44,307    |           | 44,837    |         | 511       | 2,356     |
| 18                         |        |         |         |         |           |         | 43,556    | 67,087    | 22,421    |         |           | 1,373     |
| 19                         |        |         |         |         |           |         | 51,893    | 89,253    | 80,171    |         |           | 168       |
| 20                         |        |         |         |         |           |         | 22,143    | 94,580    | 13,319    | 452     |           | 1,722     |
| 21                         |        |         |         | 14,399  | 51,984    |         | 17,494    | 73,372    | 4,598     | 1,337   | 8,131     |           |
| 22                         |        |         |         | 10,630  | 67,331    | 30,235  |           | 52,020    |           | 160     | 11,012    | 792       |
| 23                         |        |         |         | 14,252  | 62,943    | 52,410  |           |           | 22,260    |         | 12,804    | 258       |
| 24                         | 4,014  |         |         | 9,783   |           |         | 73,061    |           | 277,405   |         | 6,364     | 2,634     |
| 25                         | 6,199  |         |         |         |           |         | 94,884    |           | 6,769     |         |           | 3,842     |
| 26                         | 4,346  |         |         |         |           |         |           |           | 17,815    |         |           | 802       |
| 27                         |        |         |         |         | 162,816   |         |           |           |           | 92      | 145       |           |
| 28                         |        |         |         |         | 116,752   |         |           |           |           | 800     | 186       |           |
| 29                         |        |         |         | 47,077  | 156,081   |         |           | 234,354   |           | 93      | 33        | 1,305     |
| 30                         | 19,972 |         |         | 33,591  | 195,990   |         |           | 91,263    |           |         | 8         | 1,094     |
| 31                         | 10,697 |         |         | 11,710  | 218,385   | 183,264 |           |           | 42,564    |         | 30        | 923       |
|                            | 8,253  |         |         |         | 249,106   | 52,971  | 11,044    |           | 145,499   |         |           |           |
|                            |        |         |         |         | 173,652   |         | 6,457     | 49        |           |         |           |           |
| Totals                     | 53,481 | 159,625 | 122,755 | 147,291 | 1,658,465 | 525,095 | 1,141,332 | 1,162,410 | 3,423,809 | 71,153  | 72,382    | 31,042    |
| Troll                      | 26     | 388     | 75      | 57      | 1,092     | 426     | 287       | 365       | 109       | 23      |           | 1         |
| Monthly                    |        |         |         |         |           |         |           |           |           |         |           |           |
| Totals                     | 53,507 | 160,013 | 122,830 | 147,348 | 1,659,557 | 525,521 | 1,141,619 | 1,162,775 | 3,423,918 | 71,176  | 72,382    | 31,043    |
| June, Oct. and Nov. Totals |        |         |         |         |           |         |           |           | 120,334   | 1,927   | 384       | 9,051     |
| Season Totals              |        |         |         |         |           |         |           |           | 5,257,316 | 758,637 | 1,337,215 | 1,350,217 |





TABLE V  
 INDIAN CATCHES OF SOCKEYE SALMON BY DISTRICTS AND  
 THE VARIOUS AREAS WITHIN THESE DISTRICTS, 1966, 1970

| <i>District and Area</i>                    | 1966           |                          | 1970           |                          |
|---------------------------------------------|----------------|--------------------------|----------------|--------------------------|
|                                             | <i>Catch</i>   | <i>No. of Fishermen*</i> | <i>Catch</i>   | <i>No. of Fishermen*</i> |
| <b>HARRISON-BIRKENHEAD</b>                  |                |                          |                |                          |
| Skookumchuck and Douglas .....              | 995            | 21                       | 400            | 8                        |
| Birkenhead River and Lillooet Lake .....    | 3,905          | 35                       | 6,000          | 35                       |
| Harrison and Chehalis .....                 | 1,600          | 31                       | 600            | 12                       |
| <b>TOTALS</b> .....                         | <b>6,500</b>   | <b>87</b>                | <b>7,000</b>   | <b>55</b>                |
| <b>LOWER FRASER</b>                         |                |                          |                |                          |
| Coquitlam to Chilliwack .....               | 18,032         |                          | 7,475          | 63                       |
| Chilliwack to Hope .....                    | 43,060         |                          | 19,915         | 45                       |
| Vedder River and Vicinity .....             | 175            |                          |                |                          |
| <b>TOTALS</b> .....                         | <b>61,267</b>  | <b>240**</b>             | <b>27,390</b>  | <b>108</b>               |
| <b>MIDDLE FRASER</b>                        |                |                          |                |                          |
| Hope to Lytton .....                        | 39,100         | 208                      | 47,990         | 302                      |
| Lytton to Lillooet .....                    | 5,600          | 52                       | 6,520          | 50                       |
| Bridge River Rapids to Churn Creek .....    | 11,150         | 134                      | 33,425         | 300                      |
| <b>TOTALS</b> .....                         | <b>55,850</b>  | <b>394</b>               | <b>87,935</b>  | <b>652</b>               |
| <b>CHILCOTIN</b>                            |                |                          |                |                          |
| Farwell Canyon .....                        | 1,500          |                          | 700            | 20                       |
| Hances Canyon .....                         | 494            |                          | 348            | 34                       |
| Alexis Creek .....                          | 1,087          |                          | 1,029          | 26                       |
| Siwash Bridge .....                         | 3,553          |                          | 1,527          | 40                       |
| Keighley Holes .....                        | 1,918          |                          | 302            |                          |
| <b>TOTALS</b> .....                         | <b>8,552</b>   | <b>100</b>               | <b>3,906</b>   | <b>120</b>               |
| <b>UPPER FRASER</b>                         |                |                          |                |                          |
| Churn Creek to Chimney Creek ....           | 550            |                          | 1,800          | 78                       |
| Soda Creek .....                            | 875            |                          | 500            | 39                       |
| Quesnel .....                               | 345            |                          | 325            | 27                       |
| Shelley .....                               | 87             | 14                       | 107            | 21                       |
| <b>TOTALS</b> .....                         | <b>1,857</b>   | <b>132</b>               | <b>2,732</b>   | <b>165</b>               |
| <b>NECHAKO</b>                              |                |                          |                |                          |
| Nautley Reserve .....                       | 1,839          | 19                       | 1,240          | 14                       |
| Stella Reserve .....                        | 2,340          | 19                       | 2,883          | 21                       |
| <b>TOTALS</b> .....                         | <b>4,179</b>   | <b>38</b>                | <b>4,123</b>   | <b>35</b>                |
| <b>STUART</b>                               |                |                          |                |                          |
| Fort St. James .....                        | 1,352          | 37                       | 977            | 29                       |
| Tachie, Pinchi and Trembleur Villages ..... | 1,502          | 56                       | 1,975          | 48                       |
| <b>TOTALS</b> .....                         | <b>2,854</b>   | <b>93</b>                | <b>2,952</b>   | <b>77</b>                |
| <b>THOMPSON</b>                             |                |                          |                |                          |
| Main Thompson River .....                   | 10,600         | 98                       | 11,735         | 280                      |
| North Thompson River .....                  | 600            | 26                       | 750            | 33                       |
| South Thompson River .....                  | 1,800          | 119                      | 2,600          | 105                      |
| <b>TOTALS</b> .....                         | <b>13,000</b>  | <b>243</b>               | <b>15,085</b>  | <b>418</b>               |
| <b>GRAND TOTALS</b> .....                   | <b>154,059</b> |                          | <b>151,123</b> |                          |

\* Number of permits issued to Indians in district.

\*\* 45 of these permits transferred into the Hope to Lytton area.

The Indian catch statistics detailed above are obtained principally from the Conservation Officers of the Department of Fisheries and Forestry of Canada. These officers control the taking of sockeye for food by the Indian population residing throughout the Fraser River watershed.

TABLE VI

## SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1958, 1962, 1966, 1970

| District and Streams        | 1970<br>Period of<br>Peak Spawning | Estimated Number of Sockeye |           |           |           | Jacks  | Sex Ratio |           |
|-----------------------------|------------------------------------|-----------------------------|-----------|-----------|-----------|--------|-----------|-----------|
|                             |                                    | 1958                        | 1962      | 1966      | 1970      |        | Males     | Females   |
|                             |                                    |                             |           |           |           |        | 4-5 yr.   | 4-5 yr.   |
| LOWER FRASER                |                                    |                             |           |           |           |        |           |           |
| Cultus Lake .....           | Nov. 15-20                         | 14,097                      | 27,070    | 17,464    | 15,149    | 1,203  | 5,778     | 8,163     |
| Upper Pitt River .....      | Sept. 14-17                        | 10,385                      | 16,585    | 20,867    | 6,657     | 15     | 3,414     | 3,228     |
| Widgeon Slough .....        | Nov. 2-5                           | 1,152                       | 599       | 884       | 364       | 3      | 203       | 158       |
| HARRISON                    |                                    |                             |           |           |           |        |           |           |
| Big Silver Creek .....      | Sept. 28-Oct. 1                    | —                           | 490       | 329       | 261       | 37     | 112       | 112       |
| Harrison River .....        | Nov. 27-30                         | 14,701                      | 8,162     | 32,672    | 12,675    | 9      | 6,147     | 6,519     |
| Weaver Creek .....          | Oct. 24-28                         | 36,199                      | 15,962    | 20,416    | 11,096    | 661    | 5,183     | 5,252     |
| LILLOOET                    |                                    |                             |           |           |           |        |           |           |
| Birkenhead River .....      | Sept. 24-26                        | 33,055                      | 52,146    | 81,134    | 72,760    | 42,104 | 9,847     | 20,809    |
| SETON - ANDERSON            |                                    |                             |           |           |           |        |           |           |
| Gates Creek .....           | Aug. 30-Sept. 1                    | 81                          | 1,046     | 592       | 803       | 725    | 47        | 31        |
| Portage Creek .....         | Oct. 31-Nov. 2                     | 4,803                       | 12,034    | 31,844    | 3,901     | 28     | 1,709     | 2,164     |
| SOUTH THOMPSON              |                                    |                             |           |           |           |        |           |           |
| Seymour River .....         | Sept. 6-10                         | 78,575                      | 58,104    | 28,754    | 14,375    | 20     | 7,233     | 7,122     |
| Eagle River .....           | Sept. 8-11                         | 31                          | 169       | 338       | 23        | 0      | 10        | 13        |
| Scotch Creek .....          | Sept. 1-3                          | —                           | 7         | 459       | 304       | 0      | 137       | 167       |
| Anstey River .....          | Sept. 8-11                         | —                           | 77        | —         | 196       | 0      | 88        | 108       |
| Upper Adams River .....     | Sept. 7-9                          | Present                     | 85        | 63        | 4         | 0      | 2         | 2         |
| Lower Adams River .....     | Oct. 19-30                         | 1,730,609                   | 984,447   | 1,180,105 | 1,280,288 | 23,355 | 552,022   | 704,911   |
| Little River .....          | Oct. 19-30                         | 409,480                     | 115,881   | 105,288   | 222,393   | 4,145  | 95,374    | 122,874   |
| South Thompson River .....  | Oct. 19-30                         | 123,864                     | 19,152    | 10,586    | 5,891     | 110    | 2,526     | 3,255     |
| Lower Shuswap River .....   | Oct. 17-20                         | 9,387                       | 31,205    | 24,629    | 29,074    | 275    | 14,175    | 14,624    |
| Middle Shuswap River .....  | Oct. 19-22                         | 499                         | 457       | 1,872     | 4,559     | 0      | 2,244     | 2,315     |
| Diverted Sockeye .....      | —                                  | 1,006,177                   | 0         | 0         | 0         | 0      | 0         | 0         |
| NORTH THOMPSON              |                                    |                             |           |           |           |        |           |           |
| Raft River .....            | Sept. 10-12                        | 10,215                      | 7,613     | 6,250     | 4,474     | 12     | 2,025     | 2,437     |
| Barriere River .....        | Aug. 29-31                         | 0                           | 14        | 4         | 2         | 0      | 1         | 1         |
| North Thompson River .....  | Sept. 26-28                        | —                           | 90        | 46        | 270       | 0      | 122       | 148       |
| CHILCOTIN                   |                                    |                             |           |           |           |        |           |           |
| Chilko River .....          | Sept. 22-24                        | 137,081                     | 92,467    | 226,702   | 145,049   | 9,661  | 63,483    | 71,905    |
| Taseko Lake .....           | —                                  | 7,538                       | 657       | 353       | Present   | —      | —         | —         |
| QUESNEL                     |                                    |                             |           |           |           |        |           |           |
| Horsefly River .....        | Sept. 4-7                          | 1,784                       | 1,001     | 1,607     | 1,350     | 5      | 453       | 892       |
| Mitchell River .....        | —                                  | 65                          | 5         | 142       | 23        | 0      | 8         | 15        |
| Little Horsefly River ..... | —                                  | 14                          | 72        | 4         | —         | —      | —         | —         |
| NECHAKO                     |                                    |                             |           |           |           |        |           |           |
| Endako River .....          | —                                  | 522                         | 236       | 5         | 0         | 0      | 0         | 0         |
| Nadina River (Early) .....  | Aug. 19-22                         | 804                         | 450       | 83        | 93        | 0      | 41        | 52        |
| (Late) .....                | Sept. 18-22                        | —                           | 1,683     | 1,784     | 4,671     | 12     | 2,041     | 2,618     |
| Nithi River .....           | —                                  | 5                           | 25        | 0         | 0         | 0      | 0         | 0         |
| Ormonde Creek .....         | —                                  | 210                         | 47        | 5         | 0         | 0      | 0         | 0         |
| Stellako River .....        | Sept. 29-Oct. 2                    | 112,273                     | 124,495   | 101,684   | 45,876    | 79     | 16,600    | 29,197    |
| STUART                      |                                    |                             |           |           |           |        |           |           |
| Early Runs                  |                                    |                             |           |           |           |        |           |           |
| Ankwil Creek .....          | Aug. 4-6                           | 461                         | 290       | 86        | 220       | 0      | 99        | 121       |
| Driftwood River .....       | Aug. 2-4                           | 1,897                       | 374       | 140       | 1,983     | 0      | 889       | 1,094     |
| Dust Creek .....            | Aug. 3-5                           | 3,017                       | 1,035     | 178       | 963       | 0      | 432       | 531       |
| Felix Creek .....           | Aug. 2-9                           | 515                         | 1,600     | 979       | 2,866     | 0      | 1,346     | 1,520     |
| 25 Mile Creek .....         | —                                  | 218                         | 25        | 0         | 0         | 0      | 0         | 0         |
| 15 Mile Creek .....         | —                                  | 105                         | 25        | 0         | 0         | 0      | 0         | 0         |
| 5 Mile Creek .....          | Aug. 2-4                           | 111                         | 11        | 0         | 108       | 0      | 48        | 60        |
| Forfar Creek .....          | Aug. 4-6                           | 8,715                       | 4,464     | 1,739     | 6,476     | 16     | 2,942     | 3,518     |
| Frypan Creek .....          | Aug. 3-5                           | 57                          | 243       | 58        | 130       | 0      | 58        | 72        |
| Gluske Creek .....          | Aug. 2-4                           | 1,642                       | 1,841     | 1,876     | 5,702     | 57     | 2,432     | 3,213     |
| Kynoch Creek .....          | Aug. 3-5                           | 9,477                       | 8,672     | 3,591     | 6,495     | 27     | 2,677     | 3,791     |
| Narrows Creek .....         | Aug. 4-6                           | 1,823                       | 666       | 322       | 144       | 0      | 65        | 79        |
| Paula Creek .....           | Aug. 3-5                           | 333                         | 405       | 0         | 565       | 0      | 262       | 303       |
| Rossette Creek .....        | Aug. 5-7                           | 3,735                       | 4,887     | 1,645     | 7,664     | 77     | 3,269     | 4,318     |
| Sakeniche River .....       | —                                  | 500                         | 20        | 2         | 0         | 0      | 0         | 0         |
| Sandpoint Creek .....       | Aug. 1-3                           | 875                         | 243       | 0         | 358       | 0      | 156       | 202       |
| Shale Creek .....           | Aug. 2-4                           | 657                         | 306       | 50        | 34        | 0      | 15        | 19        |
| Misc. Streams .....         | Aug. 2-5                           | 492                         | 339       | 193       | 858       | 0      | 381       | 477       |
| Late Runs                   |                                    |                             |           |           |           |        |           |           |
| Kazchek Creek .....         | Sept. 16-18                        | 369                         | 77        | 144       | 74        | 0      | 32        | 42        |
| Middle River .....          | Sept. 20-24                        | 7,762                       | 11,706    | 4,917     | 12,115    | 22     | 5,655     | 6,438     |
| Pinchi Creek .....          | —                                  | 850                         | 142       | 76        | 0         | 0      | 0         | 0         |
| Tachie River .....          | Sept. 20-23                        | 13,738                      | 6,764     | 3,600     | 2,776     | 55     | 1,073     | 1,648     |
| NORTHEAST                   |                                    |                             |           |           |           |        |           |           |
| Upper Bowron River .....    | Aug. 27-30                         | 14,871                      | 6,292     | 2,480     | 1,341     | 36     | 563       | 742       |
| TOTALS*                     |                                    | 3,815,826                   | 1,622,960 | 1,919,336 | 1,948,171 | 82,831 | 820,350   | 1,044,990 |

\* Totals include small numbers of fish in small tributaries not listed in the table.



TABLE VII  
DAILY CATCH OF SOCKEYE, 1955-1959-1963-1967 FROM UNITED STATES CONVENTION WATERS

| Date                                   | JULY    |         |         | AUGUST  |           |           | SEPTEMBER |           |  |
|----------------------------------------|---------|---------|---------|---------|-----------|-----------|-----------|-----------|--|
|                                        | 1955    | 1959    | 1963    | 1967    | 1955      | 1959      | 1963      | 1967      |  |
| 1                                      |         |         |         |         | 53,990    |           | 112,848   | 83,010    |  |
| 2                                      |         |         |         |         | 75,245    |           | 72,265    | 94,322    |  |
| 3                                      |         |         |         |         | 45,368    |           |           |           |  |
| 4                                      |         |         |         |         |           | 51,046    |           |           |  |
| 5                                      | 7,228   |         |         |         |           | 91,067    |           |           |  |
| 6                                      | 12,418  |         |         |         |           | 89,417    | 81,546    |           |  |
| 7                                      | 6,713   |         |         |         |           | 139,733   | 48,585    | 5,594     |  |
| 8                                      | 3,409   |         |         |         | 48,429    | 167,337   | 29,274    | 88,268    |  |
| 9                                      |         |         |         | 251     | 81,369    | 132,596   | 18,439    | 58,194    |  |
| 10                                     |         |         |         | 4,465   | 54,024    |           |           |           |  |
| 11                                     | 7,824   |         |         | 3,762   | 40,503    | 93,493    |           |           |  |
| 12                                     | 8,251   |         |         |         | 25,131    | 124,278   |           |           |  |
| 13                                     | 7,563   |         |         |         |           | 80,698    |           |           |  |
| 14                                     | 7,265   |         |         |         |           | 74,075    |           |           |  |
| 15                                     |         |         |         |         |           |           |           |           |  |
| 16                                     |         |         |         |         | 30,632    |           | 37,789    | 152,217   |  |
| 17                                     |         |         |         | 1,145   | 32,409    |           | 12,228    | 115,530   |  |
| 18                                     | 16,903  |         |         | 16,742  | 31,554    |           | 14,300    | 104,995   |  |
| 19                                     | 17,687  |         |         | 12,781  | 43,279    |           |           | 64,753    |  |
| 20                                     | 13,795  |         |         |         | 27,280    | 83,286    |           |           |  |
| 21                                     | 11,878  |         |         |         | 2,222     | 64,087    |           |           |  |
| 22                                     |         |         |         |         |           |           |           |           |  |
| 23                                     |         |         |         |         | 16,714    |           | 6,193     | 142       |  |
| 24                                     |         |         |         |         | 12,623    |           | 4,269     | 70        |  |
| 25                                     |         |         |         | 5,072   | 17,133    |           | 2,680     | 76        |  |
| 26                                     | 38,584  |         |         | 103,996 |           |           |           | 189,061   |  |
| 27                                     | 13,949  |         |         | 74,382  | 10,967    | 924       |           | 197,978   |  |
| 28                                     | 29,915  |         |         | 67,596  | 8,413     | 125,615   |           | 156,371   |  |
| 29                                     | 30,647  |         |         | 54,405  |           | 67,372    |           | 108,378   |  |
| 30                                     |         |         |         |         |           | 17,846    | 2,648     |           |  |
| 31                                     |         |         |         |         | 10,136    | 33,994    | 2,686     |           |  |
|                                        |         |         |         |         | 5,821     |           | 2,330     |           |  |
|                                        |         |         |         |         | 5,372     |           | 151       | 41,810    |  |
|                                        |         |         |         |         | 4,307     | 29,018    |           | 27,915    |  |
|                                        |         |         |         |         |           |           |           | 31,254    |  |
| Totals                                 | 234,029 | 127,587 | 861,998 | 497,080 | 682,921   | 1,591,005 | 448,231   | 1,519,650 |  |
| Troll and Outside Seine Monthly Totals | 10,011  | 437     | 240     | 143     | 63,702    | 4,188     | 203       | 34        |  |
| June, Oct. and Nov. Totals             | 244,040 | 128,024 | 862,238 | 497,223 | 746,623   | 1,595,193 | 488,434   | 1,519,684 |  |
| Season Totals                          |         |         |         |         |           |           |           |           |  |
|                                        |         |         |         |         | 1,006,610 | 1,810,738 | 1,314,045 | 2,087,826 |  |

TABLE VIII  
DAILY CATCH OF SOCKEYE, 1955-1959-1963-1967 FROM CANADIAN CONVENTION WATERS

| Date                              | JULY    |        |         |         | AUGUST  |           |         |           | SEPTEMBER |           |         |           |
|-----------------------------------|---------|--------|---------|---------|---------|-----------|---------|-----------|-----------|-----------|---------|-----------|
|                                   | 1955    | 1959   | 1963    | 1967    | 1955    | 1959      | 1963    | 1967      | 1955      | 1959      | 1963    | 1967      |
| 1                                 |         |        |         |         | 12,463  |           |         | 19,223    | 6,361     | 18,874    |         |           |
| 2                                 |         |        |         |         | 53,491  |           |         | 16,577    | 486       | 19,749    | 11,459  |           |
| 3                                 |         |        |         |         | 44,447  |           |         |           |           | 6,740     | 8,062   | 2,170     |
| 4                                 | 8,734   |        |         |         | 41,692  | 15,439    |         |           |           | 1,581     | 10,160  | 29,490    |
| 5                                 | 13,388  |        |         |         |         | 5,000     | 91,288  |           | 22,777    |           | 106     | 27,699    |
| 6                                 | 9,539   |        |         |         |         | Strike    | 54,485  | 73,831    | 17,051    | 3,831     |         | 476       |
| 7                                 | 7,305   |        |         |         |         | July 26   | 44,820  | 184,860   | 14,849    | 7,269     |         | 639       |
| 8                                 |         |        |         |         |         | Aug. 9    | 9,987   | 89,770    | 12,715    | 14,422    |         | 441       |
| 9                                 |         |        |         |         | 64,348  | Incl.     |         | 114,059   | 128       | 27,728    | 15,879  |           |
| 10                                |         |        |         |         | 61,049  | 228,536   |         |           |           | 31,362    | 57      |           |
| 11                                | 5,701   |        |         |         | 66,105  |           | 59,034  |           | 146       | 306       | 12      | 55,886    |
| 12                                | 5,122   |        |         |         | 38,165  | 125,006   | 27,942  |           | 31,216    |           |         | 37,370    |
| 13                                | 5,984   |        |         |         |         | 127,041   | 8,205   | 183,161   | 16,921    | 24,349    |         | 793       |
| 14                                | 5,960   |        |         |         |         |           | 5,783   | 129,684   | 29        | 22,769    |         | 318       |
| 15                                |         |        |         |         | 41,061  |           |         | 104,460   | 3         |           |         |           |
| 16                                |         |        |         |         | 52,783  |           |         |           |           |           |         |           |
| 17                                |         |        |         |         | 31,403  | 165,960   |         |           |           |           |         |           |
| 18                                | 9,561   |        |         | 10,864  | 29,679  | 83,683    |         |           | 9         |           |         | 650       |
| 19                                | 7,827   |        |         | 8,744   | 16,703  | 41,091    |         |           | 8         |           |         | 371       |
| 20                                | 10,906  |        |         | 6,984   |         |           |         |           | 10        |           |         | 208       |
| 21                                | 20,569  |        |         |         |         |           |         |           | 1         |           |         |           |
| 22                                |         |        |         |         |         |           |         |           |           |           |         |           |
| 23                                |         |        |         |         | 12,249  |           | 43,585  |           |           |           |         |           |
| 24                                |         |        |         |         | 27,296  |           | 13,553  |           |           |           |         |           |
| 25                                | 58,985  |        |         |         | 24,536  | 55,943    | 3,146   | 115,565   |           | 19,365    |         |           |
| 26                                | 45,546  |        |         | 47,625  | 21,638  | 104,920   | 3,979   | 76,188    |           | 10,636    |         |           |
| 27                                | 26,579  |        |         | 21,971  | 7,510   | 49,084    | 1,955   | 36,132    |           | 19,305    | 15,557  | 50,985    |
| 28                                | 14,064  |        |         | 27,672  |         | 32,174    |         |           |           | 15,459    |         |           |
| 29                                |         |        |         | 26,691  |         |           | 11,487  |           |           |           | 6       | 234       |
| 30                                |         |        |         |         |         |           | 15,577  | 66,008    |           |           | 0       | 115       |
| 31                                |         |        |         |         | 4,356   |           | 1,175   | 24,586    |           |           |         | 108       |
|                                   |         |        |         |         | 20,417  |           | 1,276   | 5,799     |           | 2         |         |           |
|                                   |         |        |         |         | 10,126  | 31,096    | 590     | 4,370     |           | 1         |         |           |
| Totals ..                         | 255,770 | 38,657 | 124,437 | 243,042 | 681,517 | 1,226,939 | 468,687 | 1,244,273 | 122,711   | 283,117   | 61,304  | 207,953   |
| Troll and                         |         |        |         |         |         |           |         |           |           |           |         |           |
| Outside Seine                     | 534     | 2,163  | 1,673   | 32,565  | 39,667  | 21,458    | 5,028   | 125,490   |           | 608       | 3,057   | 3,470     |
| Spring Salmon                     |         |        |         |         |         |           |         |           |           |           |         |           |
| Gill Nets                         |         | 506    | 732     | 1,142   |         |           |         |           | 693       | 37        | 618     |           |
| Monthly                           |         |        |         |         |         |           |         |           |           |           |         |           |
| Totals                            | 256,304 | 41,326 | 126,842 | 276,749 | 721,184 | 1,248,397 | 473,715 | 1,369,763 | 123,404   | 283,762   | 64,979  | 211,423   |
| April, June, Oct. and Nov. Totals |         |        |         |         |         |           |         |           | 7,189     | 8,398     | 21,145  | 17,547    |
| Season Totals                     |         |        |         |         |         |           |         |           | 1,108,081 | 1,581,883 | 686,681 | 1,875,482 |

TABLE IX

| <i>District and Streams</i> | <i>1967<br/>Period of<br/>Peak Spawning</i> | <i>Estimated Number of Sockeye</i> |         |           |           |
|-----------------------------|---------------------------------------------|------------------------------------|---------|-----------|-----------|
|                             |                                             | 1955                               | 1959    | 1963      | 1967      |
| <b>LOWER FRASER</b>         |                                             |                                    |         |           |           |
| Cultus Lake .....           | Nov. 15-20                                  | 26,000                             | 48,461  | 20,571    | 33,492    |
| Upper Pitt River .....      | Sept. 7-10                                  | 17,552                             | 15,740  | 12,680    | 10,300    |
| Widgeon Slough .....        | Nov. 1-4                                    | —                                  | 637     | 353       | 1,006     |
| <b>HARRISON</b>             |                                             |                                    |         |           |           |
| Big Silver Creek .....      | —                                           | 191                                | 64      | 9         | 0         |
| Harrison River .....        | Nov. 16-20                                  | 5,595                              | 28,562  | 22,287    | 20,577    |
| Weaver Creek .....          | Oct. 14-17                                  | 21,330                             | 8,379   | 14,469    | 22,617    |
| <b>LILLOOET</b>             |                                             |                                    |         |           |           |
| Birkenhead River .....      | Sept. 18-22                                 | 25,355                             | 38,604  | 67,151    | 58,036    |
| <b>SETON-ANDERSON</b>       |                                             |                                    |         |           |           |
| Gates Creek .....           | Sept. 1-7                                   | 86                                 | 867     | 4,858     | 1,665     |
| Portage Creek .....         | Oct. 24-27                                  | 43                                 | 572     | 2,011     | 6,548     |
| <b>SOUTH THOMPSON</b>       |                                             |                                    |         |           |           |
| Seymour River .....         | Sept. 1-4                                   | 9,511                              | 52,325  | 71,690    | 13,361    |
| Upper Adams River .....     | —                                           | 0                                  | 0       | 6         | —         |
| Lower Adams River .....     | Oct. 15-20                                  | 54,405                             | 113,230 | 151,373   | 765,161   |
| Little River .....          | Oct. 15-20                                  | 9,072                              | 21,080  | 5,148     | 74,490    |
| South Thompson River .....  | Oct. 15-18                                  | 0                                  | 472     | 45        | 270       |
| Lower Shuswap River .....   | Oct. 18-21                                  | 23                                 | 0       | 23        | 5,951     |
| <b>NORTH THOMPSON</b>       |                                             |                                    |         |           |           |
| Raft River .....            | Aug. 31-Sept. 3                             | 5,364                              | 10,210  | 8,724     | 1,303     |
| Barriere River .....        | Aug. 25-28                                  | 103                                | 203     | 92        | 16        |
| Fennell Creek .....         | Aug. 29-Sept. 1                             | —                                  | 27      | 439       | 920       |
| North Thompson River .....  | —                                           | —                                  | —       | 70        | —         |
| <b>CHILCOTIN</b>            |                                             |                                    |         |           |           |
| Chilko River .....          | Sept. 24-27                                 | 128,081                            | 470,621 | 1,002,252 | 176,337   |
| Taseko Lake .....           | Aug. 25-28                                  | 4,400                              | 16,410  | 31,667    | 5,700     |
| <b>QUESNEL</b>              |                                             |                                    |         |           |           |
| Horsefly River .....        | Sept. 1-5                                   | 62                                 | Present | 86        | 119       |
| Little Horsefly River ..... | —                                           | —                                  | 27      | 0         | —         |
| <b>NECHAKO</b>              |                                             |                                    |         |           |           |
| Endako River .....          | Aug. 25-30                                  | 594                                | 1,463   | 2,540     | 949       |
| Nadina River (Early) .....  | Aug. 24-27                                  | —                                  | 351     | 1,019     | 1,595     |
| (Late) .....                | Sept. 14-18                                 | 202                                | 1,013   | 7,304     | 7,790     |
| Nithi River .....           | Aug. 17-20                                  | 79                                 | 218     | 763       | 1,688     |
| Ormonde Creek .....         | —                                           | 27                                 | 74      | 41        | 0         |
| Stellako River .....        | Sept. 24-28                                 | 51,971                             | 79,355  | 138,805   | 90,680    |
| <b>STUART</b>               |                                             |                                    |         |           |           |
| <i>Early Runs</i>           |                                             |                                    |         |           |           |
| Driftwood River .....       | Aug. 8-10                                   | 0                                  | 3       | 14        | 52        |
| Forfar Creek .....          | Aug. 6-9                                    | 68                                 | 281     | 652       | 4,815     |
| Gluske Creek .....          | Aug. 4-8                                    | 99                                 | 97      | 0         | 1,368     |
| Kynoch Creek .....          | Aug. 4-8                                    | 1,029                              | 1,123   | 2,147     | 6,694     |
| Narrows Creek .....         | Aug. 8-11                                   | 27                                 | 167     | 180       | 454       |
| Rossette Creek .....        | Aug. 6-8                                    | 916                                | 911     | 1,600     | 6,566     |
| Misc. Streams .....         | Aug. 8-16                                   | 31                                 | 81      | 34        | 1,120     |
| <i>Late Runs</i>            |                                             |                                    |         |           |           |
| Kazchek Creek .....         | Sept. 10-12                                 | 18                                 | 7       | 364       | 92        |
| Middle River .....          | Sept. 19-23                                 | 3,596                              | 3,500   | 1,838     | 972       |
| Tachie River .....          | Sept. 20-22                                 | 4,000                              | 2,500   | 1,035     | 576       |
| <b>NORTHEAST</b>            |                                             |                                    |         |           |           |
| Upper Bowron River .....    | Aug. 28-Sept. 1                             | 9,355                              | 29,247  | 25,144    | 31,695    |
| <b>TOTALS*</b>              |                                             | 379,185                            | 946,882 | 1,599,484 | 1,355,295 |

\* Totals include small numbers of fish in small tributaries not listed in the table.



TABLE X  
DAILY CATCH OF PINKS, 1963-1965-1967-1969 FROM UNITED STATES CONVENTION WATERS

| Date                       | JULY   |         |       |        | AUGUST    |         |         |         | SEPTEMBER |         |           |         |
|----------------------------|--------|---------|-------|--------|-----------|---------|---------|---------|-----------|---------|-----------|---------|
|                            | 1963   | 1965    | 1967  | 1969   | 1963      | 1965    | 1967    | 1969    | 1963      | 1965    | 1967      | 1969    |
| 1                          |        |         |       | 13     | 52,307    |         | 7,164   |         |           |         | 145,934   |         |
| 2                          |        |         |       | 36     | 48,241    |         | 8,084   |         | 386,713   |         |           | 124,314 |
| 3                          |        |         |       |        |           | 2,533   |         | 2,689   | 215,316   |         |           | 161,294 |
| 4                          |        |         |       |        |           | 1,312   |         | 1,941   | 75,268    |         |           |         |
| 5                          |        |         |       |        |           | 6,736   |         | 2,099   | 61,129    |         |           |         |
| 6                          |        | 84      |       |        | 68,013    |         | 199     |         |           |         | 362,417   |         |
| 7                          |        | 124     |       |        | 52,218    |         | 6,635   |         |           | 108,690 | 261,626   |         |
| 8                          |        |         |       | 23     | 40,441    |         | 10,666  |         |           | 68,470  | 144,223   |         |
| 9                          |        |         |       | 25     | 30,906    |         |         |         |           | 27,983  |           | 2,418   |
| 10                         |        |         | 2     | 33     |           | 14,502  |         |         | 103,803   |         |           | 8,677   |
| 11                         |        |         | 29    |        |           | 11,818  |         |         | 193,448   |         |           | 127,783 |
| 12                         |        |         | 39    |        |           | 11,865  |         |         | 188,781   |         |           | 57,856  |
| 13                         |        | 674     |       |        | 102,743   |         |         | 3,627   |           |         | 157,616   |         |
| 14                         |        | 483     |       |        | 98,389    |         | 24,236  | 1,783   |           |         | 149,560   |         |
| 15                         |        |         |       | 443    | 84,776    |         | 41,126  | 2,521   |           | 13,716  | 124,201   |         |
| 16                         |        |         |       | 362    |           |         | 45,622  | 2,081   |           | 4,316   | 89,874    |         |
| 17                         |        |         | 10    |        |           |         | 53,414  |         |           | 109     |           | 42,946  |
| 18                         |        |         | 322   |        |           | 29,700  |         |         |           | 46      |           | 19,249  |
| 19                         |        |         | 209   |        |           | 26,038  |         |         |           |         |           | 1,072   |
| 20                         |        | 1,729   |       |        | 173,834   |         |         | 17,014  | 91,403    |         | 96,316    |         |
| 21                         |        | 2,504   |       |        | 166,400   |         |         | 22,877  | 24,221    |         | 48,221    |         |
| 22                         |        | 2,272   |       | 967    | 181,808   |         |         |         |           |         |           |         |
| 23                         | 7,831  |         |       | 547    |           |         | 133,050 |         |           | 6,185   | 39,802    |         |
| 24                         | 19,156 |         | 275   | 665    |           |         | 191,662 |         |           | 2,036   | 17,651    |         |
| 25                         | 17,490 |         | 6,873 |        |           |         | 140,804 |         |           | 2,099   |           | 16,381  |
| 26                         | 35,819 |         | 6,010 |        |           |         | 172,829 |         | 26        |         |           | 19,181  |
| 27                         | 27,844 |         | 5,622 |        |           |         |         | 98,003  | 41        |         | 943       | 11,860  |
| 28                         | 22,440 |         | 5,952 |        |           | 60,960  |         | 119,947 | 23        |         | 769       | 5,347   |
| 29                         |        | 3,799   |       | 2,080  | 427,506   | 46,508  |         |         | 14        |         | 323       |         |
| 30                         |        | 3,469   |       | 2,565  | 349,273   |         |         |         |           | 940     |           |         |
| 31                         |        | 44,316  |       | 1,259  | 263,222   |         |         |         |           | 530     |           | 4,461   |
|                            |        | 44,595  |       | 10,619 | 164,078   |         |         |         |           | 335     |           | 2,265   |
| Totals                     |        | 257,117 |       | 9,018  | 2,304,155 | 227,089 |         |         | 1,352,939 | 238,037 | 1,639,476 | 605,104 |
| Troll                      |        | 133,114 |       | 5,524  | 327,235   | 53,630  |         |         | 20,550    | 1,832   | 9,297     | 1,267   |
| Monthly Totals             |        | 21,986  |       | 14,542 | 2,631,390 | 280,719 |         |         | 1,373,489 | 239,869 | 1,648,773 | 606,371 |
| June, Oct. and Nov. Totals |        | 37,124  |       |        |           |         |         |         | 31,122    | 668     | 8,927     | 17,600  |
| Season Totals              |        |         |       |        |           |         |         |         | 4,426,232 | 558,380 | 3,827,040 | 945,797 |

TABLE XI  
DAILY CATCH OF PINKS, 1963-1965-1967-1969 FROM CANADIAN CONVENTION WATERS

[illegible]

TABLE XII  
SUMMARY OF THE PINK SALMON ESCAPEMENT TO THE  
FRASER RIVER SPAWNING AREAS

| District and Streams                    | 1969<br>Period of<br>Peak Spawning | Estimated Number of Pink Salmon |           |           |           |
|-----------------------------------------|------------------------------------|---------------------------------|-----------|-----------|-----------|
|                                         |                                    | 1963                            | 1965      | 1967      | 1969      |
| EARLY RUNS                              |                                    |                                 |           |           |           |
| LOWER FRASER                            |                                    |                                 |           |           |           |
| Main Fraser .....                       | Oct. 8-15                          | 516,831                         | 543,757   | 785,797   | 848,532   |
| HARRISON                                |                                    |                                 |           |           |           |
| Chehalis River .....                    | Oct. 10-14                         | 12,394                          | 7,621     | 5,625     | 7,147     |
| FRASER CANYON                           |                                    |                                 |           |           |           |
| Coquihalla River .....                  | Oct. 10-16                         | 14,971                          | 3,845     | 3,045     | 2,415     |
| Jones Creek .....                       | Oct. 10-16                         | 3,500                           | 3,000     | 3,162     | 1,779     |
| Misc. Tributaries .....                 | Oct. 10-16                         | 4,081                           | 1,057     | 2,395     | 450       |
| SETON - ANDERSON                        |                                    |                                 |           |           |           |
| Seton Creek .....                       | Oct. 10-17                         | 121,424                         | 95,046    | 225,351   | 198,854   |
| Portage Creek .....                     | Oct. 10-17                         | 8,013                           | 5,931     | 7,822     | 1,092     |
| Bridge River .....                      | Oct. 12-18                         | 6,422                           | 23,657    | 6,547     | 13,034    |
| THOMPSON                                |                                    |                                 |           |           |           |
| Thompson River<br>and Tributaries ..... | Oct. 10-18                         | 285,243                         | 233,100   | 450,487   | 247,896   |
| TOTALS* .....                           |                                    | 972,879                         | 917,736   | 1,490,231 | 1,321,199 |
| LATE RUNS                               |                                    |                                 |           |           |           |
| LOWER FRASER                            |                                    |                                 |           |           |           |
| Stave River .....                       | —                                  | 910                             | 226       | 276       | —         |
| HARRISON                                |                                    |                                 |           |           |           |
| Harrison River .....                    | Oct. 16-20                         | 645,476                         | 69,213    | 64,576    | 96,390    |
| Weaver Creek .....                      | Oct. 16-20                         | 693                             | 528       | 786       | 725       |
| CHILLIWACK-VEDDER                       |                                    |                                 |           |           |           |
| Chilliwack-Vedder River .....           | Oct. 21-25                         | 317,750                         | 193,911   | 252,585   | 92,222    |
| Sweltzer Creek .....                    | Oct. 18-29                         | 15,215                          | 8,908     | 19,586    | 18,923    |
| TOTALS* .....                           |                                    | 980,453                         | 273,387   | 341,141   | 208,260   |
| GRAND TOTALS .....                      |                                    | 1,953,332                       | 1,191,123 | 1,831,372 | 1,529,459 |

\* Totals include small numbers of fish in small tributaries not listed in the table.



## STAFF

Loyd A. Royal, Director

### NEW WESTMINSTER

F. J. Andrew  
O. Brockwell  
Miss D. Chandler  
A. B. Chapman  
A. C. Cooper, Chief Engineer  
W. Davis  
Miss S. Dykstra  
P. Gilhousen  
Miss J. C. Goodman  
D. Hembrough  
H. K. Hiltz  
L. W. Johnston  
R. Kent  
S. R. Killick  
E. B. Phillips  
J. Pyper

J. F. Roos, Chief Biologist  
Mrs. F. Sato  
P. B. Saxvik  
Mrs. D. Short  
C. H. Smardon  
D. Stelter  
R. A. Stewart  
Miss M. Tabata  
Miss B. Tasaka  
W. Tomkinson  
Mrs. A. Townsend  
Mrs. V. Troup  
Mrs. S. Usher  
J. Weir  
Mrs. R. Wien  
L. V. Woods

### SWELTZER CREEK LABORATORY

E. L. Brannon  
P. M. Buck  
J. Elderkin  
Mrs. M. Ferguson  
T. W. Gjernes  
R. W. Gordon  
J. M. Johnston  
D. W. Martens

L. Molnar  
E. Nessel  
D. Procter  
Mrs. B. Rannie  
Dr. J. A. Servizi, Laboratory Director  
V. A. Tolvanen  
I. V. Williams  
W. L. Woodall

### HELL'S GATE FISHWAYS

H. S. Dunlop

F. R. Johnston

### UPPER PITT FIELD STATION

W. E. Keillor

### WEAVER CREEK CHANNEL

B. A. Van Horlick

### GATES CREEK CHANNEL

G. Randall

### SETON CREEK CHANNELS

E. Pierce

### CHILKO LAKE

F. G. Scott

